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A Comparative Study of Taxonomic Methods for the Classification of Personality

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A COMPARATIVE STUDY OF TAXONOMIC METHODS FOR THE CLASSIFICATION OF PERSONALITY

By

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CHAPTER I

THE PROBLEM

This dissertation is part of a larger research project undertaken by the Department of Psychology of Loyola University. The object of the research project was to study the life and ministry of the Catholic Priesthood in the United States.

One of the problems which developed in the overall research project was that of classifying or describing various types of adjustment in a way that could be easily understood by anyone outside the profession of psychology.

This dissertation was proposed for determining the best method by which this problem of taxonomy could be resolved. There are essentially three different models by which one can approach a problem of this type. The first alternative at one's disposal would be intuitive judgment. Factor analysis is another alternative that has also been used successfully in this type of problem. There is, however, a controversy concerning the proper coefficient upon which the factor analysis should be performed (cf. Nunnally, 1967). The traditional method in psychology was to use a correlation matrix but recently this has been challenged and a covariance matrix has been suggested as a more suitable alternative. Within the last ten years in the field of biology a third model has been introduced which has been subsumed under the generic name of cluster analysis (Sokal and Sneath, 1963). It is also more properly called numerical taxonomy, suggesting a contrast to the first model mentioned above, namely, an intuitive judgment. Here again two different coefficients have been suggested upon which the cluster analysis can be performed.

The research design, proposed in this dissertation, was to try all three models mentioned above, along with the various coefficients upon which they can be performed, on the same group of subjects (namely, a sample from the data collected from the Loyola Priest Study) in order to compare and evaluate the results obtained from each method. It seems at present that a stage in technology has been reached where this type of study is imperative. No longer can it be assumed that any one of various methods of analysis is as adequate for a task as another one might be. There is need for comparative studies in order to avoid possible bias in choosing our method and design of analysis. In the monograph Multivariate Behavioral Research, Gullahorn (1967) discussed this methodological-comparative type of research:

> Let me now turn to the impact of technological change on the decision situation in the Mid-1960's. By then, the increased speed and memory capacity of the modern hardware and the development of accompanying software, or of libraries of programs, meant that the techniques

> previously judged too slow and too expensive for the expected payoff actually were faster and cheaper...
>
> Structuring the decision situation in order to choose among alternative methods and virtually neglecting the possibility of applying more than one analysis actually reflects a necessity imposed by limitations of the past and not by present contingencies. I am not here advocating indiscriminate application of different methods simply because they are available. However, when present information indicates that alternative techniques appear appropriate for analyzing a set of data, it seems desirable that researchers expend the extra time and effort to perform alternative analyses of the same data in order to develop a body of empirical comparisons that will contribute to our knowledge of research methodology. (p. 10)

The purposes of this dissertation were to explore the various methods by which a taxonomy of personality adjustment could be constructed and to introduce numerical taxonomy as a possible alternative to the models used at present, namely an intuitive judgment and factor analysis. The study took the form of a comparison of the three models mentioned above along with the alternative coefficients suggested under each model. The design was similar to a study recently published by True and Matson (1970) concerning the relationship of archeological methodologies. Moreover, a discriminant analysis was performed on the results of each model as a statistical test of the "goodness of fit" for that model. The major null hypotheses tested in the research project were as follows:

I. Any one of three models, namely an intuitive judgment, factor analysis and cluster analysis, is as good as any other for the purpose of forming ideal personality types.

II. Within the factor analytic model, the results obtained by using a matrix constructed with a correlation coefficient do not differ from the results obtained by using a matrix constructed with a covariance coefficient.

III. Within the cluster analytic model, the results obtained by using a matrix constructed with a similarity coefficient do not differ from the results obtained by using a matrix constructed with a distance coefficient.

CHAPTER II

REVIEW OF THE RELATED LITERATURE

This review is limited to the literature on taxonomy since the main purpose of this dissertation is to study the various methods used for this purpose. It appears from the problem itself as presented in Chapter I that there are three main divisions into which the review of the literature can be broken. The first concerns the use of factor analysis and the controversy over which coefficient is the more appropriate for a problem of this type. The second section, covering material relatively new to the field of psychology, will examine various methods of numerical taxonomy used as a model for this type of problem. The third section will discuss the application of numerical taxonomy in other fields to problems similar to that of typing personality.

A. FACTOR ANALYSIS

Several methods of factor analysis have been used successfully in the taxonomic problem. Factor analysis is a methodology for specifying the fundamental independent variables, or vectors of a matrix, which are found in a larger group of dependent variables. It enables one to judge which of a large number of arbitrarily specified and defined variables may be regarded as the fundamental independent ones of a set.

The usual procedure in descriptive psychology for a problem of typology or profile analysis is the Q technique of Cattell (1952). In this method a correlation matrix is formed by correlating the subjects across the variables. From this matrix of correlations various methods of extracting the factors or independent vectors are used. One can consult a work like Harman (1967) for a comparison of these methods. They all produce similar results. Much depends upon whether one has access to computer facilities. The factor extraction describes the interrelationships among the subjects in terms of an arbitrary orthogonal (uncorrelated) system. The first factor usually accounts for much of the variation among subjects, the second for somewhat less and the third still less, and so on. The relative amounts of information contained in each factor can be determined and are usually expressed as a percentage of the total amount of information.

Gordon, in a series of recent studies (1960, 1967, and 1969) has assessed the utility of information obtained from this method. In the last study he tested the typological model by factor analyzing intercorrelations based on the mean scores of The Survey of Interpersonal Values (cf. Gordon, 1969) for 59 different subjects. He also repeated the study using the Edwards Personal Preference Schedule (Edwards, 1959). The outcome of these analyses was highly positive. Four factors emerged for each study and in the first study accounted for 98 percent of the variance. Mean trait scores of the defined groups were meaningful and consistent with the known group characteristics. In addition, individual correlation coefficients between groups were found to be interpretable in their own right. Gordon suggested in his conclusion, "The Q typing methodology will be of value for studying the image of political figures, the development of job families on the basis of similarities in motivational or other personality variables, and related applications." (1960)

There have been many other studies using the Q technique. Only two recent studies will be mentioned to show that the method is still current and a popular model for the solution of this type of problem. Yufit (1969) studied college students using Erikson's (1950) theoretical framework of ego growth and development called the "Eight Ages of Man". Yufit turned up six clearly defined types on the basis of this classification. Jay, in another study (1969), found three groups by factoring 40 questions from the dogmatism scale of Rokeach (1960).

Nunnally (1967), however, criticized the Q technique of factor analysis for this type of problem. He pointed out that there are three major types of information in the profile of scores for any person. They are level, dispersion and shape. The <u>level</u> is defined by the mean score of the person over the variables in the profile. The level is not directly interpretable if the variables are from very different domains of behavior, as would be the case if they consisted of a personality test concerning mental illness, a reasoning test and measures of height and weight. Although it is conceivable that such a polyglot collection of variables would relate to the same construct, it is doubtful that a sensible interpretation of mean score (level) on these measurements could be made. Even if the variables are all related to the same domain of behavior, the level would still be difficult to interpret if the variables were "pointed" in different directions. This would be the case for four tests concerning aspects of illness if on two of the tests a high score indicates sickness while on the other two tests a high score indicates adjustment.

Dispersion indicates how widely the scores in the profile diverge from average level. The measure of dispersion is the standard deviation of scores for each person. Whereas, it is possible to make a direct interpretation of the level, it is difficult to do so for the dispersion. The reason for this is that profiles generally depend upon the correlation among variables in the matrix. If a high positive correlation exists among the variables, the types tend to have small dispersions. If the correlation among variables is low, the dispersion tends to be larger.

The third type of information is the <u>shape</u>, which concerns the "ups" and "downs" of the profile. Even though persons might have the same level and dispersion, the high and low points for the two might be different. The shape, although unrelated to the level, is somewhat related to the dispersion, in so far that if the dispersion is small, the shape does not have room to show much difference in performance. The shape, although it does not depend upon the dispersion, must fit within it. Also, when the shape is small, the observed differences may be due to measurement errors. Therefore, unless the dispersion is relatively large it may be hazardous to interpret the shape of a particular profile.

In Cattell's Q technique the measure of profile similarity or relationship is the product-moment correlation coefficient. A correlation coefficient is constructed between each subject in the study. To do this the measurements for each person are standardized. The level for each profile would be subtracted from scores on each of the variables for a given profile, and each deviation score would be divided by the profile dispersion for that person. In the same way the profiles for all persons would be standardized. The resulting correlation matrix would then contain only one measure of the degree of relationship or similarity between the two profiles, that of shape. The reason for this is that the mechanics of computing the product-moment formula equates all profiles for level and dispersion. The level of all the profiles is zero, and the standard deviation is 1.0.

If six profiles are ploted on a graph this loss of level will perhaps become more evident. In Figure 1, Profiles A, B and C are similar to each other and profiles D, E and F are likewise similar to each other. If all six profiles are compared according to the product-moment correlation (that is, Cattell's Q technique) the profiles would be classed as similar or as forming only one group, since the correlation is sensitive only to similarities in shape. Yet it is obvious that the six profiles are not congruent because they are split into two markedly different levels. This is the reason why Nunnally proposes, as an alternative to the factoring of Cattell's correlation matrix, the factoring of the covariance or raw score cross products matrix formed from pairs of profiles. By avoiding the standardization of raw scores Nunnally is able to take into account similarities of both level and dispersion. In Figure 1, subject A, B and C would then group into one cluster while subject D, E and F would group into a separate cluster. The difference between the two clusters is that of level which Cattell's Q technique is unable to detect.

Only three recent studies of taxonomy in psychology

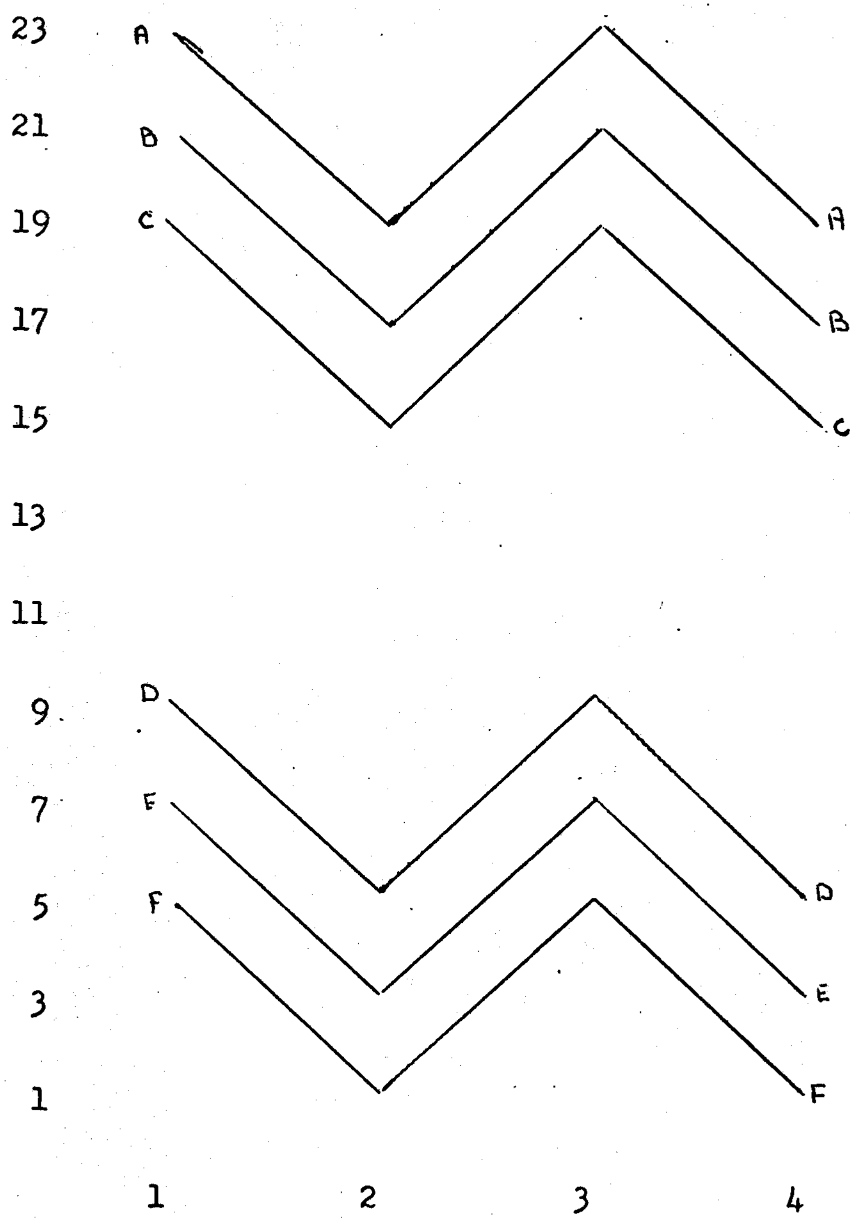


Fig. 1. Comparison of profiles to bring out the difference between level and shape.

have been found which have actually used Nonnally's method. They are Tucker (1963), Guertin (1966) and Wiggins (1969). The reason so few studies have used this method is suggested by Nunnally himself (1967 p. 380), "Some persons are evidently unaware that raw score cross-products can be factored in the same way that correlation coefficients are factored. The failure to realize that factor analysis is not restricted to correlation coefficients is either directly evident or implied in many papers concerning methods of clustering profiles." None of the three studies, however, make any effort to justify the use of Nunnally's method in preference to Cattell's method. No studies were found where the two methods are actually compared.

B. NUMERICAL TAXONOMY

"Numerical taxonomy is the evaluation of numerical methods of the similarity of distance between taxonomic units and the employment of these affinities in erecting a hierarchical order of taxa." (cf. Sokal and Sneath, 1963) The ideas on which numerical taxonomy rests go back to Adanson (1757, 1763), a contemporary of Linnaeus, and have been repeatedly voiced in the field of biology. The present method has undergone considerable modification and development during the last ten years. This is a direct result of first, the research and study that has gone into the understanding of the mathematical models upon which the method is used and second, in the development of large, high speed computers which are needed to perform the computations.

Sokal and Sneath (1963) in their now classic work, Principles of Numerical Taxonomy, state, "The various techniques for computing resemblances between taxa can conveniently be grouped into three types of coefficients, those of association, correlation and distance." Only the first and third are properly considered under numerical taxonomy or cluster analysis today. The second, that of grouping by correlation is generally associated with factor analysis. Although grouping by correlation has frequently been used in psychology, the first study in biology was undertaken by Sokal and Michener in 1958, about the same time that the first work with the other two coefficients were begun. For this reason all three were grouped together by Sokal and Sneath in the work mentioned above. There is considerable difference, however, in the mathematical models upon which they are based and for this reason, it is thought more appropriate today to distinguish between them.

Another way the problem can be viewed is to divide the methods of analysis according to the various ways in which the unspecified matrices of coefficients are split or broken into subgroups. Rohlf (1970), in a recent article entitled "Adoptive Hierarchical Clustering Schemes" has tried to approach the problem from this standpoint and has distinguished, "three classes of methods." He calls the first Multi-dimensional scaling in which one obtains the coordinate axes of each operational taxonomic unit (O.T.U.) in the smallest dimensional space that still preserves sufficient information about the interpoint distance. This usually is called factor analysis. The second method is called network analysis. Here one attempts to construct a non-directed graph out of the various measurements and then decompose the graph by various methods into tightly structured subgraphs. The third method identified by Rohlf is called cluster analysis. This method usually employs a stepwise procedure to build up a hierarchy of classes. It proceeds in the opposite direction from network analysis wherein a large group is formed and then broken into subgroups; in the cluster analysis, however, a small nucleus is first formed and then these are gradually combined in a hierarchical manner until a single system results.

The failure to distinguish between these two approaches in grouping the methods of numerical taxonomy, namely that of Sokal and Sneath on the one hand and that of Rohlf on the other, has led to considerable confusion in the literature on this subject. The confusion results from the fact that the two groupings are not disjunctive and overlap to a considerable degree. Most authors seem to follow either one or the other of the groupings. The confusion that exists in the literature appears only when one tries to put the whole picture together. Consequently, it seems a new scheme should be introduced. The basic structure of the taxonomy could be the older grouping of Sokal and Sneath which divides the clustering methods according to the coefficients that are used in the original matrices. Each of these could be further subdivided according to the algorithm by which this matrix is split into groups and clusters. Not only is this the logical way to present the methods but it helps eliminate the confusion that exists in the literature, placing each method in its proper perpective. The scheme is as follows:

A) Similarity Coefficient
   1) Graph method
   2) Hill climbing or hierarchical method.

B) Distance Coefficient
   1) Single linkage
   2) Complete linkage
   3) Average linkage
   4) Centroid linkage.

This outline will be followed for the second section of the review of the literature.

I Similarity Coefficients.

In a number of studies concerning the problem of clustering, a fixed coefficient of similarity between each pair of objects (O.T.U's.) has been used to describe the amount of separation between objects. This coefficient usually ranges from 0 (for perfectly dissimilar objects) to 1.0 (for perfectly similar objects). One often uses such a coefficient rather than a distance function when dealing with data which are discrete, (that is, a variable which may have several states rather than a continuous range). Distance, such as Euclidean distance, which ranges from zero for identical objects to some maximum value within a given set of data, is more often applied to continuous (nondiscrete) variables. Euclidean distance, however, has the disadvantage that two objects may be far apart solely because their values on one variable differ widely. With a similarity coefficient, the divergence that can be caused by a single variable is strictly limited. These limitations have recently been overcome by methods for example constructed by Rubin and Friedman (1967) and Owen (1968) and now both coefficients are used indiscriminantly with either discrete or continuous variables.

Several coefficients which measure the similarity of a pair of objects have been proposed. A list is given in Sokal and Sneath's Principles of Numerical Taxonomy. The fundamental formula consists of the number of matches divided by the possible number of comparisons. For example, if we had N discrete variables the simplest coefficient of similarity that can be defined between to O.T.U's, i and j is:

$$\text{Fractional match } S_{ij} = \frac{\text{No. of matches}}{\text{No. of variables}} = \frac{M}{N}$$

Thus, if we have five variables, each of which can take on four states: A, B, C, D; and furthermore, if these four states exhaust the logical possibilities for each variable, then for objects one and two given in Table 1 there are two matches (on variables one and four).

The fractional match coefficient for this example would be $S_{1,2} = \frac{2}{5} = .40$.

TABLE I

Example of Fractional Match Coefficient

	Variables				
	1	2	3	4	5
Object No. 1	A	B	C	D	C
Object No. 2	A	C	D	D	B

A great deal of discussion has been carried on whether negative matches should be incorporated into the coefficient of similarity. Sneath (1957b) excluded negative matches from consideration in his similarity coefficients. He felt that it was difficult to decide which negative features to include in a study and which to exclude. Both Sokal and Michener (1958) and Rogers and Tanimoto (1960) hold that "negative" states are of equal value and interest as "positive" states. They argue that the proper selection of variables should forestall such improper procedures as suggested by Sneath. Most of the applications of similarity coefficients have included negative matches in their coefficients.

The following are the three most common coefficients used today:

TABLE 2

Three Most Common Similarity Coefficients

Sokal and Michener	$S_{ij} = \frac{M}{(M + U)} = \frac{M}{N}$
Rogers and Tanimoto	$S_{ij} = \frac{M}{(M + 2U)}$
Dice and Sorensen	$S_{ij} = \frac{2M}{(2M + U)}$

With regard to the selection of the most appropriate coefficient, Rubin and Friedman (1967b) summed up the state of the question thus:

> Considering the arbitrariness of the concept of a similarity coefficient, our work has been limited to the use of one of these two out of a host of possible coefficients. Either coefficient may be used...In practice, results don't seem to differ greatly whichever of the two is chosen. (p. 56)

After the similarity matrix has been constructed there are two possible ways in which one can proceed to extract the clusters. Either one can begin with the whole and attempt to split this into parts (the graph and network method) or one can take the individual degrees of similarity and attempt through some hierarchical or hill-climbing method to show how the individual parts can eventually be grouped into a single whole. In this way the density of the clusters will depend upon the threshold of similarity or cutoff point where one wished to stop the process. These are essentially the two methods described above in the article by Rohlf (cf. 1970).

A. Network analysis:

The method described here is essentially that of Owen (1968). After a similarity matrix has been constructed using one of the above coefficients of similarity, a threshold is chosen for the construction of a nondirective graph. The links in this graph are the connections of similarity between all O.T.U's. which have a similarity above the given threshold. This graph is then decomposed into a series of subgraphs which are constructed in such a way that the subgraph with the largest number of vertices for the given connection ratio is found first followed by those of successively smaller size until only single vertices, if existent, remain. These subgraphs will all contain complete linkage according to the threshold of similarity chosen for the construction of the original graph. Dense graphs usually respond better to higher threshold requirements; sparse graphs require lower values. A hierarchical structure is then produced from the subgraph obtained from the decomposition by condensing them through successively higher levels of fewer but larger subgraphs until a level is reached at which the entire graph is reassembled. A breakoff point can be chosen anywhere within the hierarchy to form many or few clusters according to the level chosen.

B Hill-climbing method:

The method described here is that of Rubin and Friedman (1967b). A set of data are described as "well-structured" when it can be split into groups so that the similarity coefficient of objects in the same group ("within-group co-efficients") are higher than coefficients of objects in different groups ("between-group coefficients"). The breaking value should be between the within-group and the between-group coefficients. This splitting function is defined in terms of what Rubin and Friedman call "parameter S*." For a given value of S* two objects can be defined as "similar" if they have a coefficient greater that S*. In this case they are grouped together to form a cluster. The optimum partitions for different values of S* define a hierarchy which is called a "tree". At one end of the tree (S* = 0) the optimal partition should be the conjoint partition. If each optimal partition over a relatively long interval of S* should contain a group which does not change (or changes very little) from level to level, then this group should be considered as a candidate for a "natural cluster" or an independent group.

II. DISTANCE COEFFICIENT:

It is necessary to begin by explaining what is meant by distance. This coefficient was first developed by Mahalanobis (1936). Assume that there are four subjects for which two characters or variables have been measured and upon which a comparison is to be made. The state of each character may be assigned values along a scale ranging from zero to one. A pair of rectangular coordinates can be drawn in which the abscissa represents character X and the ordinate character Y. The position of the subjects can be plotted with respect to these axes. See Figure 2.

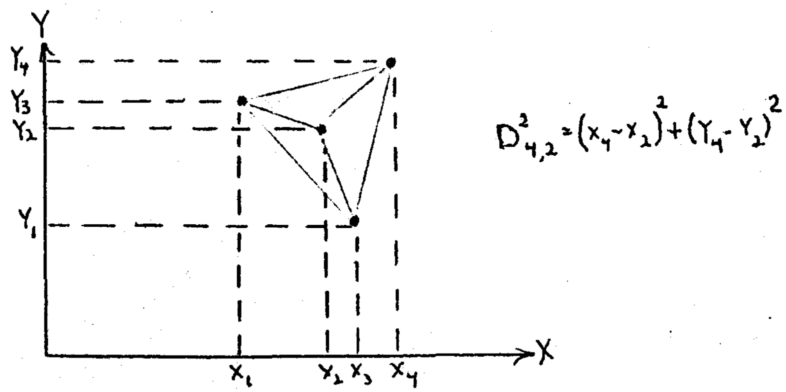


Fig. 2. Plot of distance between four points or subjects.

If two of the subjects are identical with respect to the two characters under consideration, their position will coincide and the distance between them will be zero. The greater the disparity between the character, the greater the distance. This distance is seen as the complement of similarity. If we wish to estimate taxonomic distance on the basis of three characteristics, we must add a third coordinate to our diagram. Adding a fourth and subsequent characters cannot be visualized geometrically. However, the requirement of each new coordinate axis is that it be at right angles with all previous ones. Although we cannot depict such an axis graphically, we can postulate its existence and demonstrate algebraically that most of the geometric theorems of conventional three-dimensional space can be extended to it. This N dimensional space is what is known as Euclidean hyperspace.

In a general sense, clusters are thought of as collections of points (subjects) which are relatively close but are separated from other clusters by empty regions of space. The major effort in the development of classification methods has been directed towards the definition of a satisfactory analysis which yields groupings that possess the minimum variance within groups and the maximum variance between groups.

Most of the methods of cluster analysis are performed in a stepwise fashion. Subjects most related are first clustered. Gradually more and more members are admitted into the cluster by adjusting the criteria of admission. One can summerize these methods into four different divisions as follows:

1) Clustering by single linkage

This method is one of the earliest used. It was discussed by Sneath (1957) and is directly related to elementary linkage analysis. A subject is admitted by what is called the criterion of single linkage. By this is meant if a similarity level of .88 would admit a subject into a cluster, a single linkage between any member of that level would warrant admission. The difficulty with this method is what has been called the chaining effect. While two clusters may be linked by this technique on the basis of a single bond, many of the members of the two clusters may be quite removed from each other. An example of this would be A and B in Figure 3. Because of a single link or bond between any member of the cluster suffices for its inclusion in that cluster, the distance between two extreme members (A and B) could be very great. When that happens, as can be seen in Figure 3, it is possible that the extreme members (A and B) have little resemblance and therefore little reason for being included in the same type.

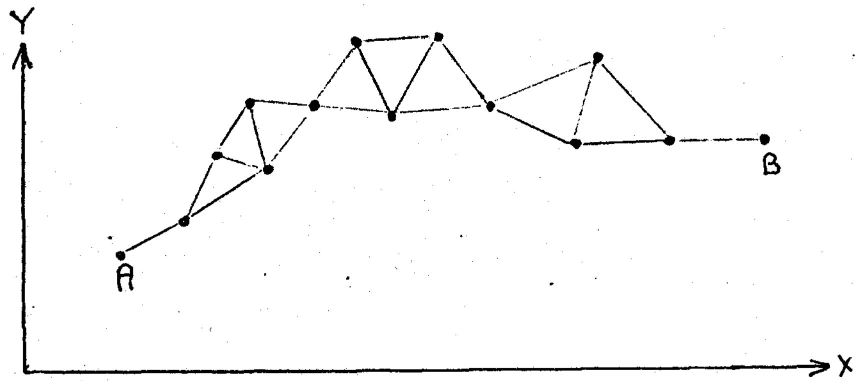


Fig. 3. Chaining effect which results from single linkage.

2) Clustering by complex linkage

This method, described by Sorensen (1948) for ecological studies, has not been used in numerical taxonomy (Sokal and Sneath, 1963). It corresponds in many details to Sneath's single linkage method, except that subjects are admitted into the cluster by what is called the complete linkage criterion. A given subject joining a cluster at a certain similarity coefficient must have relations at that level or above with every member of the cluster. This is interpreted to mean that the maximum distance between any two cluster points must not exceed a threshold which defines the maximum permitted diameter of the cluster subset.

3) Clustering by average linkage

This method is a class of clustering techniques proposed by Sokal and Michener (1958). They based the admission of any individual into a cluster on the average or arithmetic means of the similarities between the individuals which make up the group. In one version of this method, the similarity between groups is a weighted average of similarities between the members of the group. The weights are usually chosen to give greater weight to forms which enter groups late in the clustering process. As new forms or groups of forms enter they are given weights equal to the sum of weights of the forms already in the group. In another version unweighted averages are used.

Lance and Williams (1966a, 1966b, 1967a, 1967b, 1968) also developed an average linkage system. Their concept begins with paired groups. The criterion of inter-group similarity is defined as the average of the similarities between all pairs of individuals. The method is a hierarchic fusion from those groups which minimize the average.

4) Clustering by centroid

This solution is the most popular and has been extensively developed in the last few years. In general, it measures the distance between the centroids of the groups. No consideration is taken of the order in which forms join or link into the group and so the method is unweighted. It differs from the average method in that the distance (that is, the similarity) between the two groups is a function not only of the average distance between groups but also of the average distance within the group.

For Bonner (1964), a critical distance threshold 'r' is chosen and an individual selected at random is used as a starting point. The first cluster consists of those points which lie within a sphere of radius 'r' about the starting point. From the remaining points another individual is chosen at random to generate the second cluster and allocation proceeds as discussed above. When all the points are allocated to clusters, each is re-allocated to its nearest cluster to form disjointed groups. The resultant clusters have a severe diameter constraint which is analogous to Sorensen's method.

For Ball and Hall (1965), k individuals, selected at random, initiate cluster centers, and then each of the remaining individuals is allocated to its nearest center. The cluster centroids are computed and any two clusters are fused if the squared distance between them is less than a determined threshold. Also, clusters are split if the variance in any one dimension x exceeds another threshold s^2. The cluster centroids replace the original centers, and the method re-allocates each datum afresh, and iterates to convergence.

MacQueen (1966) selects k random individuals to initialize cluster centers. The distance from each datum to its nearest cluster center is computed and the point is allocated to that cluster if the distance does not exceed a threshold t; when the distance exceeds this then the point initializes a new cluster center. At each allocation, the new cluster centroid is computed and replaces the original cluster center. When the distance between the centroids becomes less than another limit, the clusters are fused.

Rather than select k random individuals, Jancey (1966) selects k random points for centers and allocates each datum to its nearest cluster center. When all the points have been allocated, the nearest cluster centroids are computed, and the centers are moved to new positions relative to the centroids. The method then returns to re-allocate and iterates to convergence. The result at convergence is that the final cluster centers are situated at their centroids.

In search of the ideal minimum-variance solution, Forgey (1965) adopts Ward's hierarchical process (1963) to obtain a part-optimum solution for k clusters and then proceeds to reallocate cluster individuals to their nearest cluster centers. He tries to slide the partitions back and forth between each pair of centroids in an attempt to improve the error sum of squares. The final groupings are very similar to those obtained by Jancey's methods (1966).

In a recent book Tryon and Bailey (1970) define two broad classes of object clustering procedures. The first is proximity clustering, which selects object clusters on the basis of small distances between objects in score space. Core object centroids are formed. Each object is then assigned to the core object centroid from which it has the smallest distance even though the objects are shifted from one core object cluster to another in the process. The second class is colinearity clustering, which select object clusters on the basis of proportionality of patterns in the score profiles, not directly depending on the profile elevation. The first procedure seems to be the addition of Bailey and properly is classified under the centroid method of clustering a distance matrix. The second procedure is that of Tryon which was previously published under the name of Cumulative Communality Cluster Analysis (cf. Tryon, 1939, 1958a). This is a method similar to factor analysis, and was explicitly constructed to replace Thurstone's Centroid Method (cf. Tryon, 1958b). With the advent of the computer, both methods have fallen into disuse.

The last method to be considered under this section will be that of Rubin and Friedman (1967a). They begin each partition of the n objects into g groups with the following matrix identity taken from Wilks (1962), $T = W + B$. This is similar to the formula upon which the scatter for the analysis of variance rests, that is, the total scatter equals the sum of the within and the between scatters. From this basic relation a criterion known as a ratio of determinants is derived. This is used as a criterion function to be maximized. In principle all partitions of the n objects into g groups are considered and that partition into g groups is chosen for which this ratio is maximum. This measure is not comparable for different values of g since its value for $k + 1$ groups will be greater than or equal to its value for k groups. Once having decided on the number of groups, the matrix W for the partition which maximizes $\left|\frac{T}{W}\right|$ determines the pairwise distance between objects.

In the form of an appendix to this section, the work of McQuitty will be considered. He has developed and refined several pattern-analytic methods which he felt useful for education and psychology. These cannot properly be classified under any of the above categories. Starting in the fifties with an elementary linkage analysis (1957), he developed several real order typal analyses (1967), an iterative intercolumnar correlational analysis (1968) and a hierarchical classification by multiple linkage (1970). Although McQuitty seems very prolific in the publication of theories he has done very little in the publication of the application of his theories to concrete problems.

C. REVIEW OF RESEARCH USING NUMERICAL TAXONOMY

The utilization of numerical taxonomy has progressed furthest in the field of biological classification. The methods of numerical taxonomy or cluster analysis were first introduced by two articles written by Sneath (1957a, 1957b) in 1957. These were followed very quickly by two other articles written by the same author (1961, 1962). Another important article was published almost simultaneously by Sokal and Michener (1957). Sokal followed this by two more important early articles, (1961, 1962). All of these early articles culminated in what is being recognized as the classic work on numerical taxonomy written jointly by Sokal and Sneath (1963). Since then many studies have been carried out in biology, both in order to compare methods of analysis and to actually classify and type various species of animals. These studies are too numerous to mention. The following are an example of a few of the more outstanding publications:

Colwell (1960), Defayalle (1962), Goodfellow (1967), Grover (1967), Ivemey-Cook (1968), Jarvis (1967), Lee (1968), and Seyfried (1968).

In the field of ecology, Hall (1965, 1967, 1968), as was mentioned above, developed a centroid linkage method for decomposing a distance matrix. Crawford (1967), in another article, compares various methods of hierarchical divisions of a set of quadrats. Austin and Orlosi (1966) illustrate the methods of analyzing a set of ecological data by both cluster analysis and principal component analysis using a matrix of weighed similarities coefficients. They concluded that the latter method was preferable. Parker-Rhodes and Jackson (1968 p. 791), in another study demonstrated the utility of what they called automatic classification. Although many individual species in their study were misclassified, they still consider their results remarkable. They attributed the misclassification to the low quality of the data, concluding that "Had the input consisted of ecological observations of the usual detailed kind, there can be little doubt that the same procedures could have delivered a classification actually superior to any available for this group of organisms."

Both Milne (1968) and Owen (1968) have been using cluster analysis in solving some of their problems of landscaping in the field of architectural design. Through numerical methods they have developed useful procedures in allocating space to similar groups in a design problem. In this way they have been able to solve many communication problems.

In 1966, Hodson, Sneath and Doran carried out a pilot study of various techniques of numerical taxonomy in the classification of archaeological material. They found the average link cluster method superior to single linkage. Their main conclusion, however, pointed out that although the experiment was successful, much study needs yet to be done in this area of application. Tugby (1965) compared the use of factor analysis and Tryon's cumulative communality cluster analysis on a sample of archaeological data. Cogwell (1967) reviewed the literature of the previous ten years concerning the application of numerical taxonomy to archaeology. He concluded, "There may be important lessons for us in the work being done in pattern-recognition by machines, but so far as I know no archaeologist has gotten beyond mentioning this as a possibility...." (p. 918) He was apparently unaware of the first two articles quoted in this paragraph. Chenhall (1968) applied numerical taxonomy in the grouping of skeletal materials. The results, however, were poor but he attributed this to the inadequacies of the data. He predicted that in the future "Computers offer the possibility of eliminating subjective interpretations in primary data almost entirely... The only limitations will be creative imagination." (p. 23) True and Matson (1970), comparing three methods of taxonomy, namely, intuitive judgment, factor analysis and cluster analysis, on a sample of archaeological data obtained almost identical results from each method.

King (1967), in the field of economics attempted to group various types of stocks and bonds by means of cluster analysis for prediction purposes. Goronnzy (1969) attempted to classify business enterprises with numerical taxonomy on the basis of several measurable characteristics. He found that average linkage methods proved most successful leading to four clusters which approximated a four way classification on the basis of size and technology.

Griffeth (1967) successfully applied numerical taxonomy to a problem of textual criticism of several classical Latin authors. The results yielded a sequence of manuscripts showing the greatest differences from each other.

In education Campbell (1966) attempted to apply cluster analysis to a set of 20 courses included in the first two years of engineering. The five clusters which resulted, indicating different types of engineers, compared favorably with a rotated factor analysis of the same material. McQuitty, in a series of articles quoted above has suggested various methods of cluster analysis for application in education. McRae (unpublished) has suggested the usefulness of using cluster analysis in grouping students into homogeneous subsets. However he has undertaken no application of this method to date.

In the field of psychology, Stringer (1967) carried out a study on clustering facial expressions. Thirty photographs were presented to a group of thirty judges who were asked to group them so as to include similar facial expressions in the same group. For each pair of photographs, an index of their similarity was constructed by counting how many judges included both of them in the same group. This similarity matrix was then subjected to a cluster analysis. Five principal disjointed clusters were found. In his conclusion he suggested that there are wider applications of both "free grouping procedures and cluster analysis."

Schoenfeldt (1966) compared factor analysis with cluster analysis grouping subjects according to a 370 item life history inventory he constructed especially for his project. His factor analysis was performed on an inter-subject cross product matrix. The cluster analysis was performed on an inter-subject matrix using Mahalanobis' generalized distance. Both procedures were highly effective in partitioning the sample into demonstrably differing subgroups. It is interesting to note that both methods used the same type of coefficient, a covariance type. The author does not, however, acknowledge this nor does he attempt to justify the use of this coefficient in preference to other possible choices.

Borgen (1970) used data estimating the reward conditions for 81 occupations to compare the Q-type factor analysis with Ward's hierarchical grouping analysis. He found that factor analysis was somewhat inferior to the hierarchical grouping method. He concluded, however, that, "the hierarchical grouping method appeared to be an efficient and effective grouping method, likely to be useful for future clustering of additional ORP data or for other taxonomic studies." (p. 105) It is interesting to note that the clustering method which used a distance coefficient, a type of covariance coefficient, was found superior to the factor analysis method which used a correlation coefficient. The author does not justify the use of his choice of coefficients.

In summing up the results of this review several points should be made. First, the rapid development of numerical taxonomy in the last ten years and its widespread application to many disciplines gives an indication of the appropriateness and timeliness of its application in the field of psychology. Second, although some studies have compared factor analysis with cluster analysis, none have further compared the use of different coefficients within each method. For example, in the last two studies cited, Schoenfeldt (1966) found both factor analysis and cluster analysis equally effective while Borgen (1970) found factor analysis inferior to cluster analysis. In both these studies, however, no importance was given to the fact that in the first study the same coefficient was used for both methods while in the second study different coefficients were used. The present dissertation will attempt to fill this gap by further comparing various coefficients for each method. (cf. Hypothesis II and III, page 4.) Third, as many of the studies have indicated, we are still in a period of experimentation and many comparative studies will yet have to be carried out in each discipline before definitive conclusions can be established which could be applicable to all fields of research.

CHAPTER III

THE DESIGN OF THE STUDY

The design of the study will be developed in three sections: the subjects and sampling procedure, the apparatus, and the method of analysis.

A. THE SUBJECTS AND SAMPLING PROCEDURE

The subjects for this dissertation were 80 priests selected from the 218 subjects collected in the Loyola Priest Study. (Kennedy and Heckler, 1971) The reasons that only 80 subjects were selected are several. This is about the size most studies of typology use and, as a result, computer programs are readily available. To do the entire sample of 218 would run into considerable expense both since programs would have to be re-written and when working with large matrices the computer time increases geometrically with the size of the matrix. A sample of 80 should be sufficient to study the utility of the various methods in a comparative research project of this type.

An explanatory note regarding the 218 subjects seems to be called for. The Department of Psychology of Loyola University and the National Opinion Research Center (NORC) of the University of Chicago have undertaken an assessment of the Roman

Catholic Priesthood in the United States at the request of the National Conference of Catholic Bishops. It was planned that the two studies, one psychological (Loyola) and the other sociological (NORC) would be undertaken separately, but since there is much overlap in the two disciplines, the sample for the two studies would be similar. In this way, information collected in one study could be used in the other.

NORC did their sampling first and attempted to sample 10% of all the priests in the United States. Since there are approximately 60,000 priests, their N was somewhat over 6,000. The Loyola Study attempted to sample 10% of the NORC sample, that is then 1% of the total population of priests in the United States. Several considerations (cf. Kennedy and Heckler, 1971) went into the decision of the actual makeup of the sample drawn from the population of American priests. First, it was important that the sample be drawn in such a way that it accurately reflect (an accurate image of) the total population of the American priesthood, so that no subgroup (younger vs. older, urban vs. rural, etc.) should be given undue emphasis. A second consideration was the deliberate inclusion of somewhat special groups (e.g. Trappists) in the study. A third consideration was cost since a totally random sampling of individual men would present grave problems of travel, time, and expense. A final consideration was the desirability of maintaining parallelism with the

NORC study mentioned earlier.

After consultation with sampling specialists at the Service Research Center at the University of Michigan and NORC, a sampling strategy was devised to give due consideration to each of these needs. A brief description of this design follows.

In order to insure that priests from all size categories would be represented, it was decided that dioceses and religious communities would be stratified according to the number of priests contained within them and then selected as first-stage sampling units or clusters. In the case of religious institutes, in addition to the size strata, two special strata were formed for the Trappists and the United States Foundations.

After they were separated into size strata, the dioceses and religious communities were arranged in geographical order according to the four major United States census regions and then sampled within each stratum. Complete lists of priests within the selected units were obtained by written request from contact persons officially designated by Bishops and Major Superiors. Subsampling was then performed at the desired rate.

The sampling plan for the present study did not attempt to estimate population parameters. Such an attempt would have required a usable number of respondents in the range of 1,200 to 1,500 priests. The technique of the in-depth interview with its high cost prohibited ever approaching this figure. Rather, the plan eventually chosen insured that no systematic bias enter into the selection of subjects. Hence, when proportions, average scores, and other statistics are cited, they are not intended to be simple point estimates of population values. Such estimates are possible, however, but were they to be made, consideration would have to be given to the statistical matters of standard error, weighting for stratification, and correction for non-response.

The process of data collection was as follows: A letter was sent to each of the original 719 subjects explaining the study and asking his cooperation. A return post card was included for each subject to indicate whether he would cooperate with the study or not. Three types of replies were obtained: the subject indicated he would cooperate, he indicated he would not cooperate, or he refused to answer. Those who indicated they would cooperate were scheduled for an interview. At the interview a battery of self-report instruments were given with the instruction that the subject should complete and return by mail. To those who replied they would not cooperate, another letter was sent asking them to reconsider or if they still chose to refuse, to indicate the reason for this refusal on an enclosed card.

For the third group who did not reply to the first mailing, a second and third followup letters were sent. After the third refusal to answer attempts to contact were discontinued.

When a priest indicated that he was willing to be interviewed, specific arrangements were made. In most cases, the priest met with the interviewer in the interviewer's room in a hotel near the priest's residence. In other cases, the psychologist conducted the interview in the priest's residence or place of work. In a very small number of cases, the interview was conducted in the psychologist's private office. As might be inferred, bringing priest and psychologist together at a given date, time and place usually hundreds of miles away, was often a very difficult task.

Of the 719 original priests, 240 stated that they were not willing to be interviewed and would not change their intention when requested to do so. The number of non respondants were 111. The number that had to be eliminated were 97. The most frequent reason for elimination was residence outside the 48 states (Alaska and Hawaii were not included). Other less frequent reasons included the following: report of having left the active ministry, hospitalization, death, missing many appointments for an interview (two priests) and being an interviewer for the study (one priest). A total of 271 priests completed the interview. Of these 271 subjects only 218 completed and returned the self-report tests. The Kennedy-Heckler taxonomy was based on the 271 subjects while the other taxonomies were constructed from a sample of 80 cases selected from the 218 returned tests.

Table 3 describes the 719 potential subjects in terms of status in this study and sampling stratum.* As can be seen in Table 3, a disproportionately large number of priests belonging to United States Foundations was eliminated. This primarily is due to residence outside of the 48 adjoining states.

Table 4 describes the 719 potential subjects by status within the study and by diocesan or religious order affiliation. Of the 424 diocesan priests initially selected, 179 (24%) were eventually interviewed. Of the 295 religious order priests initially selected, 92 (31%) were eventually interviewed. The difference in willingness to be interviewed is more striking when one considers the fact that only 25 (6%) of the diocesan priests were eliminated from participation and 72 (24%) of the religious order priests were eliminated. Elimination of religious order priests, as noted above, was primarily due to their residence outside the 48 adjoining states.

*Table 3, 4 and 5 and figure 4 along with the interpretation found in the text for each table was taken directly from The Loyola Psychological Study of the Ministry and Life of the American Priest. (cf. Kennedy & Heckler, 1971)

TABLE 3

STATUS OF SUBJECTS WITHIN THE STUDY ACCORDING TO SAMPLING STRATA

		Completed	"No"	Non-Respondent	Eliminated	Total
DIOCESE	Small	31	28	16	2	77
	Medium	44	28	13	12	97
	Large	53	48	18	3	122
	Extra Large	51	45	24	8	128
RELIGIOUS ORDER	Small	12	24	5	7	48
	Medium	16	17	9	8	50
	Large	44	35	22	26	127
	Trappist	7	3	1	1	12
	U.S. Foundations	13	12	3	30	58
TOTAL		271	240	111	97	719

TABLE 4

Status of Subjects
according to Diocesan or Religious Affiliation

	Completed		"No"		Non-respondent		Eliminated		Total in Sample	
	n.	%	n.	%	n.	%	n.	%	n.	%
Diocesan	179	66	149	62	71	64	25	26	424	59
Religious	92	34	91	38	40	36	72	74	295	41
Total	271	100	240	100	111	100	97	100	719	100

Table 5 describes the distribution of potential subjects by status within the study and by age groupings. Inspection of this table suggests that among the priests who were interviewed, there was no gross over-or under-representation of any age group. There does appear to be a slight over-representation of younger priests. In general, the younger the man, the less likely he was to refuse to be interviewed. To a degree, this tendency did not result in gross over-representation of the young. This was due to the greater rate of elimination of those under 46 years of age. Although the data are quite spotty, there is suggestion that the older the priest, the more likely he would not respond to the requests to be interviewed.

TABLE 5

Status of subjects within the sample according to age.

Age	Completed		"No"		Eliminated		Non-Respondent	
	n.	%	n.	%	n.	%	n.	%
26-35	75	28	19	10	16	22	3	9
36-45	78	29	36	18	34	47	4	12
45-55	61	22	65	32	17	23	10	32
56+	57	21	79	40	6	8	15	47
Total	271	100	199	100	73	100	32[a]	100

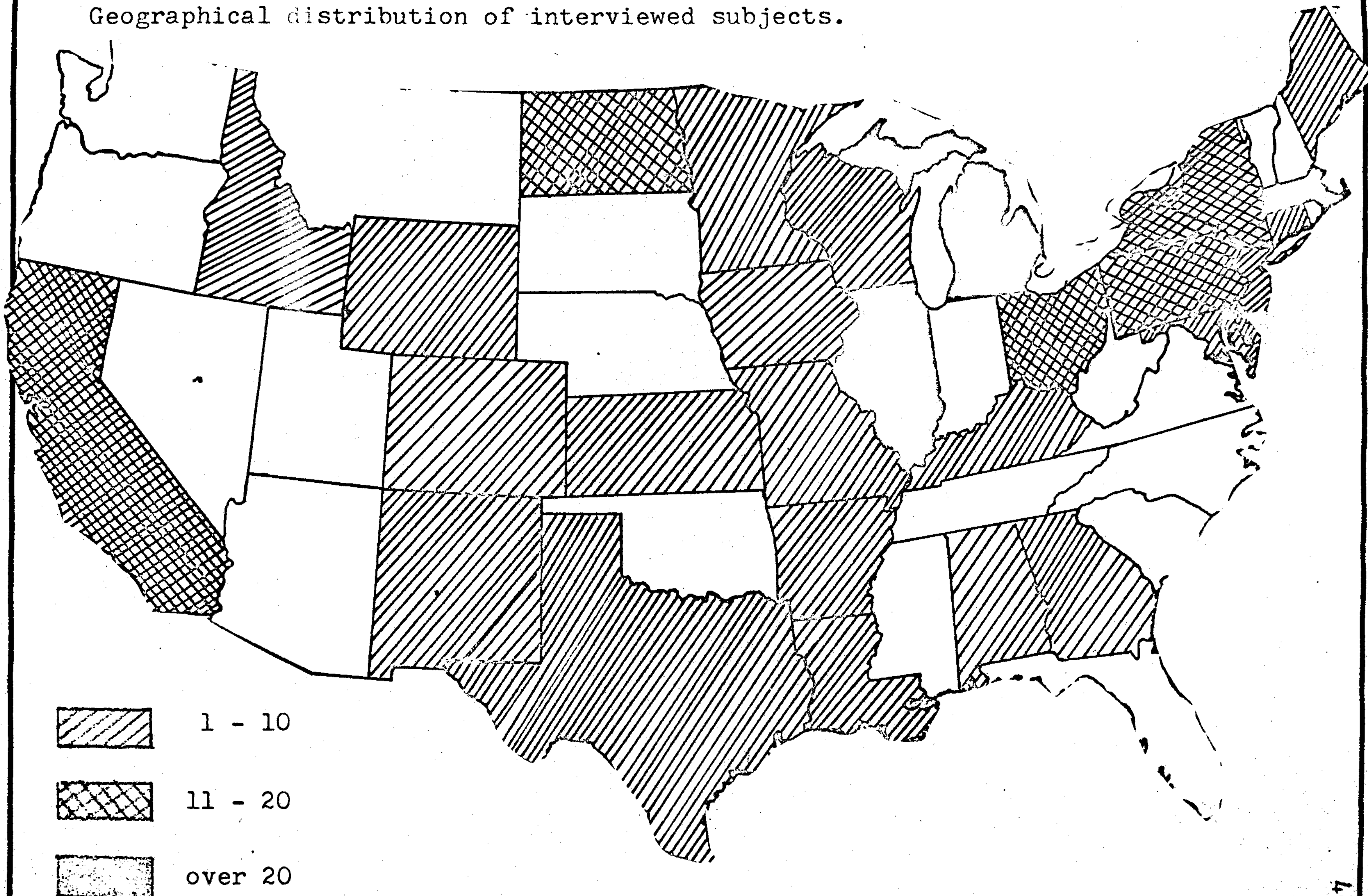
a. There was no information concerning the age of 260 non-respondents.

The geographic distribution of the interviewed priests is illustrated in Figure 4. Twenty-eight states and the District of Columbia are represented. The smallest number of interviewed subjects in any state is one (New Jersey, New Mexico, Wyoming), the largest is 29 (Illinois).

A Chi-square test was run to determine the representativeness of the sample of 80 cases selected for construction of the statistical taxonomies from the pool of 218 cases. The Kennedy-Heckler intuitive taxonomy was used for this. All the 271 cases were classified into 4 types in the Kennedy-Heckler

FIGURE 4

Geographical distribution of interviewed subjects.



taxonomy (see page 59 for an explanation of this taxonomy). The Chi-square test was run to compare the expected frequencies and observed frequencies for the four types of the Kennedy-Heckler taxonomy. The Chi-square was not significant, with a $X^2 = 2.84$ and df. = 3. (See Table 6) Thus, it is interpreted that the sample of 80 cases is not independent from the larger sample of 218 cases, that is, the sample chosen for the construction of the statistical taxonomies is representative of the larger sample in the Loyola study.

TABLE 6

Chi-square for Representativeness of the Sample.

	Kennedy study	fe	fo	$(fe - fo)^2/fe$
Type I	19	6	3	1.50
Type II	50	15	18	.60
Type III	179	53	55	.07
Type VI	23	6	4	.67
Total	271	80	80	2.84

B THE APPARATUS

The relevant data for the entire Loyola Study was collected by two methods: psychological interviews and self-report tests. The self-reports are the main data source used in this dissertation. The subjects provide these self descriptions via Shostrom's Personal Orientation Inventory, (Shostrom, 1963) Sims' Identity Scale (Henry and Sims, 1968) and Sheehan's Sentence Completion Test (Sheehan, 1971). The variables from these three self-reports will be the ones used in constructing the various statistical taxonomies.

1) Psychological Tests.

Shostrom's Personal Orientation Inventory (1963, 1964, 1969) was developed to give a comprehensive measure of values and behavior which seemed to be important in development of self-actualization (Maslow, 1954, 1962). Because the subjects are representative of a specific and relatively large profession in our society and presumed to be healthy, this test was chosen, as it tries to measure actualization rather than pathology.

The test is subdivided into a profile of 12 different scores as follows:

1) Time Incompetence /Time Competence - measures the degree to which one is 'present oriented.'
2) Inner /Other Support - measures whether reactivity orientation is basically toward others or self.
3) Self-Actualizing Value - measures affirmation of a primary

value of self-actualizing people, that is whether the person holds values of a self actualized person.

4) Existentiality - measures flexibility in the application of values.

5) Feeling Reactivity - measures sensitivity of responsiveness to one's own needs and feelings.

6) Spontaneity - measures freedom to react spontaneously or to be oneself.

7) Self-regard - measures affirmation of self because of worth or strength.

8) Self Acceptance - measures affirmation or acceptance of self in spite of weaknesses or deficiencies.

9) Nature of Man - measures the degree of the constructive view of the nature of man, whether man is essentially good.

10) Synergy - measures the ability to transcend dichotomies.

11) Acceptance of Aggression - measures the ability to accept one's natural aggressiveness as opposed to defensiveness, denial and repression of aggression.

12) Capacity for Intimate Contact - measures the ability to develop contactful intimate relationships with other human beings, unencumbered by expectations and obligations.

The Personal Orientation Inventory Manual (Shostrom 1963) reports reliability coefficients for the major scales of Time Competence and Inner Direction at .71 and .84 respectively, and coefficients for the subscales range from .55 to .85. In general the reliabilities obtained in this study are at a level as high as that reported for most personality measures. Shostrom, in an article (1964), states that he obtained coefficients of .91 and .93 by a test-retest method.

Kerlinger (1964), however, points out, "The major problem in personality measures is content validity. While reliability is a technical matter, content validity is not so treatable. To answer the validity question, 'Are we measuring what we think we are measuring?' is a complex and difficult task." The principal validity studies were carried out in order to discriminate between individuals who have attained a relatively high level of self-actualization and those who have not so evidenced such development. Shostrom found a significant discrimination on 10 scales to be at the .01 level and on one scale at the .05 level. One scale, Nature of Man, was not found to discriminate sufficiently.

The Identity Scale was developed by John Sims (1962, 1968) to elicit responses relevant to the issue of Identity-Identity Diffusion in the meaning given to this by Erikson (1950, 1959). By means of factor analysis six separate scales were identified. The first scale was divided into four more scales. Hence, the report gives a profile of nine different variables which can be described as follows:

Factor I: Identity - which is subdivided into four scales:

1) Ego-Career - designates occupational commitment vs. career diffusion.
2) Ego-Group - designates a sense of group membership vs. sense of isolation.
3) Ego-Self - designates a positive evaluation of self vs. self-abasement.
4) Ego-Affect - designates positive affective experiences vs. negative affective experiences.

Factor II: Expressivity and comfort within a social context - follows primarily from a sense of membership or 'belongingness' and only secondarily from direct interpersonal involvement.

Factor III: Individualistic Expressivity - measures that expressivity and freedom of affect which issue from within the self, rather than from amenable relationships between the individual and his society.

Factor IV: Integrity - reflects a critical but positive acceptance of one's self, of one's fellow man, and of their shared moment in history. There is a belief in the value and joy of life, and a pervading sense of fulfillment.

Factor V: Autonomy within social limits - defined as measuring the working relationship between self-direction or independence and societal demands. It recognizes that the organization of society necessitates norms of behavior, but that reasonable adherence to these need not prevent individuality or interfere with autonomous functioning.

Factor VI: Trust - defined as a deeply ingrained conviction that one's needs, material and emotional, will be satisfied, that the world and people are basically good and that one has a personal feeling of 'being all right' with oneself.

The reliability of the scales was examined by a test-retest method. Sims (1962) gives the following table (cf. Table 7) of stability on the identity scale. (Adult females, N=51)

Table 7 Sims' Reliability Data As Reported

Statistics	Results
Rank order correlation of item pair	.93
Mean absolute shift for item pair	.78
Mean difference between item pair means (time 1 vs. time 2)	.08
Proportion of item pair response deviation	
(N=51 x 56 = 2,836 responses)	
0 unit change	55%
1 unit change	28%
2 unit change	6%
3 unit change	11%

These reliabilities compare favorably with evaluation of similar techniques, e.g. Osgood's Semantic Differential (1957). His summary of studies of the stability of response suggests that mean absolute shifts between .70 and .80 are fairly typical for test-retest conditions with a one week interval.

The Sentence Completion Test (Sheehan, 1971) is a semi-projective test adapted from the Loyola Sentence Completion Test for Seminarians (Sheridan and Kobler, 1969). The instrument was designed with questions especially adapted to the profession of the Catholic Priesthood. The judgments for scoring the instrument are made on a scale of 1 to 7 in two different directions. Starting with 4 as a neutral point and working towards extremes from 3 to 1 indicating positive responses, 5 to 7 negative or conflicted responses.

In addition to yielding a total score, the instrument also measures adjustment in six different subareas:

1) Self - positively indicates self-esteem, acceptance of self, seeing oneself as independent, capable and creative. Negatively it indicates self-devaluation, depreciation, dislike of self, seeing self as unacceptable or unattractive.

2) Interpersonal Relations - positively indicates liking for others, concern for their good, ability to share with others, finding interpersonal relations rewarding. Negatively it indicates fear of others, avoidance of others, lack of rewarding experiences in interpersonal relations.

3) Psychosexual Maturity - indicates positive regard for women, finding them attractive; accepts, appreciates and shares love

and physical expressions of it. Negatively it indicates fear or avoidance of women, presence of distress in relation with women or even in the thought of contact with them.

4) Church-Faith-Religion - positively indicates acceptance and promotion of Church-Faith-Religion as important, stimulating, challenging and productive of growth for self and others. Negatively it indicates a rejection of church authority, lack of hope about the future of the Church-Faith-Religion, conflict about meaning or importance of Church-Faith-Religion for self or others.

5) Priesthood - positively finds it meaningful, satisfying to self and productive of good. Negatively it questions its validity for self or all men, doubts the maturity of fellow priests and finds priesthood dehumanizing.

6) Job Satisfaction - positively regards work as productive, growth producing and an important part of life. Negatively it regards work as a waste of time, questionable as to productivity, and unsatisfying.

On an inter-judge reliability study, two graduate students in psychology, using the manual alone for instruction on a sample N=32, obtained a coefficient of .96 for the total score and from .84 to .92 for the other scales.

The problem of validity using three different criteria was examined. The criteria were scores in the MMPI, a psychological rating, and a combination of both. The content validity coefficients for the total score were respectively .62, .66 and .86. All three were significant at the .01 level. The coefficients for the subscales were lower, as would be expected, with two scales being nonsignificant against one of the criteria but being significant at the .05 level against the other two criteria

In summary, Shostrom's Personal Orientation Inventory, Sims' Identity Scale, and Sheehan's Sentence Completion were the tests chosen for the study. A total of 27 variables or scales of measurement were obtained from each subject. It is upon these measurements that five of the taxonomies were based.

2) Clinical Interview Material.

The intuitive taxonomy included in this dissertation was constructed by Kennedy and Heckler (1971), both of the Psychology Department of Loyola University of Chicago. The data they used for the construction of their taxonomy were reports of the clinical interview.

Twelve clinical psychologists were chosen as interviewers. Each was at the Ph.D. level and a graduate of the Clinical Division of the Psychology Department of Loyola

University of Chicago.

The content of the interview was developed (cf. Kennedy and Heckler, 1971) from a survey of the literature of psychological interviewing, research on the priesthood established by the behavioral sciences, and the current sources of concern to priests as described in popular publications. Another and perhaps more influential source of content was consultations with colleagues among the clergy and hierarchy and in the disciplines of sociology, psychiatry, and psychology. The major features covered in the interviews include the following: family life and relationships, other developmental experiences, psychosexual development, self concept, development of vocation, interpersonal relationships, faith, priesthood, celibacy and personal view of the future.

The technique for evaluating the above material relied heavily upon inferences made by the interviewers. In its final form the content of the structured interview consisted of the following eight major areas: (cf. Kennedy and Heckler, 1971)

1. Interview Process. The psychologist writes a description of the priest's physical presence, and the manner in which he behaved during the interview: anxious or relaxed, passive and submissive or active and controlling, and so on. In addition, he describes how he himself felt towards the priest and how he

believes the priest felt about the interview and toward him.

2. Development. In this section the psychologist describes the priest's parents and other significant adults in his life and indicates the nature of the emotional relationships of these figures to the priest and among themselves. Also are described the relationships of the priest to his siblings, friends, and general cultural circumstances. Events which had special impact on the course of his development are noted.

3. Functioning. The psychologist then addresses himself to the functioning of the priest in the six areas listed below. He communicates his understanding by writing five interpretive statements in each area. He then ranks each statement twice; once for its salience in describing the priest and again for his degree of confidence in making the statement. The six areas are the following:

a. Interpersonal Relations. This section communicates the typical way the priest interacts with others, whom he feels most comfortable with, the degree of closeness with others, and so on.

b. Psychosexual Maturity. Here is described the level of psychosexual maturity the priest has achieved, what impact sexuality has on his life, how sexuality is linked to his vocation, etc.

c. Self-perception. The psychologist lists what the priest feels are his most important characteristics, his strengths, his weaknesses.

d. Job-satisfaction. Here are described the satisfying and frustrating elements of the priest's work life.

e. Church, Faith, Religion. The psychologist attempts to identify the priest's attitudes toward the Church, its leaders and organization, the nature of his beliefs and religious practices.

f. Priesthood. Here is described the personal meaning of the man's vocation, not so much how it should be, but how it is actually lived.

4. Report. The psychologist ties all the preceeding sections together in an integrated way, giving a comprehensive sketch of the way in which the priest's background, personality, and vocation interact.

5. Future Outlook. The psychologist makes tentative predictions about the priest's future: his vocational commitment, further personal growth, best assignments, possible need for treatment, etc.

6. Psychosocial Modalities. The psychologist makes judgments about the priest within the framework of Erik Erikson's theory of development (adapted from Prelinger and Zimet, 1964), for example, along the identity vs. identity-diffusion dimension.

7. Diagnosis. If a psychodiagnostic label is warranted, it is entered here.

8. Scale of Adjustment. The psychologist locates the overall adjustment (personal integration, occupational adaptation, and mental health) of the priest on a twelve point scale used in other studies of normal persons.

C. METHOD OF ANALYSIS

The design of the study is as follows. Six different taxonomies were established by methods described in the Review of the Literature. A discriminant analysis was then run on the taxonomies in order to test the null hypotheses stated at the end of Chapter I (cf. p. 4).

1) Typing according to an intuitive judgment.

This taxonomy was established by Kennedy and Heckler (1971) using only the clinical material of the study in the following manner:

After the 60 psychological reports obtained in the pilot study and those obtained in the field early in the data collection phase were evaluated, it seemed possible to group the priests into categories which were ordered along a continuum of development. Four major types emerged: Maldeveloped, Underdeveloped, Developing, and Developed.

Composite personality sketches of men found in each of the four categories were drawn. These sketches served as preliminary definitions of the categories. Next, a sample of 25 reports was read and categorized independently by the authors and two other psychological consultants. The level of agreement among the four raters was good. Disagreements served the purpose of clarifying important issues. For example, one rater used adaptation to vocational demands as a primary factor in his judgments. The other raters used more personal factors, such as depth of emotions and presence of satisfying interpersonal relationships, as primary indices. The matter was discussed and the latter emphases agreed upon.

The next step was the refining of each category into three levels. This resulted in a twelve point scale of development. The purpose of using a twelve point scale (four major categories with three levels within each category) rather than a four point scale (four major categories) was to achieve increased utility for further correlational studies.

Next, the authors independently read the 271 reports in their entirety. The sequence in which the reports were read was random and different for each author. They independently assigned a developmental rating on the twelve point scale to each case and wrote comments about each.

When disagreements occurred between the two raters over the category into which a priest should be placed, case conferences were held. At the case conferences, the authors resolved their differences. No use of the self-reports was made at any time.

2) Typing according to Cattell's Q Technique.

The data for the statistical part of the study were stored on IBM data cards. Two IBM cards were used for each subject and the variables were punched out on the cards using two or three columns for each variable. In order to use a Biomedical Program for the factor analysis of the data in this form it was necessary to transpose the deck or matrix so that the columns become the subjects and the rows (cards) become the variables. If this were not done an R type of factor analysis would be performed. To accomplish this a simple program using a Matrix Algebra Subroutine from Control Data, 6000 series (1966) was used.

Next, a factor analysis of this transposed matrix was performed using the Biomedical Program BMDX72 (cf. Dixon, 1970). This program contains several options. A correlation matrix was first to be computed for the factor analysis. The diagonal elements were not altered, that is, "ones" were placed in the diagonals of the correlation matrix. The minimum eigenvalue (cf. Harman, 1967, pp. 137-146) which would be factored was set at .50. Anything less than this would contain practically no variance and hence, would be of no interest. The correlation matrix, eigenvalues, cumulative proportion of the total variance, factor matrix before and after rotation, and the factor scores were to be printed in the output.

3) Typing according to Nunnally's sum of cross products.

Nunnally's analysis is somewhat more complicated to perform. Since the variables were expressed in different scales, the first operation to be performed was to "transgenerate" the different scales into equivalent scales. In effect, this is equivalent to transforming the scales into percentages. The reason for this is obvious. If two scales were multiplying a third scale, to obtain the sums of cross-products, the first with a range from 1 to 10 and the second with a range from 1 to 25, a score of 8 on the first would be of greater value than a score of 15 on the second. Thus, if these raw scores were used to compute the sum of cross-products, the actual smaller value (15) would increase the sum more than the larger (8) value unless they both were transformed into an equivalent scale. This was accomplished by making the range of the equivalent scale equal 1 to 100. In this case the first value (8 in the scale of 1 to 10) would be transformed into 80 and the second value (15 in the scale of 1 to 25) into 60. If both of these new values were then used to multiphy the third value, their true value would result.

The transgenerated matrix was then transposed in the manner described for the Cattell Q Technique. A subroutine from Control Data 6000 (1966) was used.

Next, a factor analysis was performed on this transgenerated, transposed matrix. The BMD72X (Dixon, 1970) used for the Cattell Q Type Technique was again employed but for the Nunnally technique different options were chosen. A covariance matrix was first computed from the input matrix in place of the correlation matrix used for the Cattell Q Technique. The diagonal elements remained unaltered. The factoring was to be discontinued after 10 factors were computed, since not more than five or six usable factors were expected to be found.

4) Typing according to Owen's graph method.

For the construction of the fourth taxonomy the algorithm for the decomposition of a nondirected graph (cf. Owen, 1968) was used. The algorithm had been programmed* by Charles Owen, Professor of Architectural Design of the Illinois Institute of Technology. In counter distinction to most programs

*The program is found in the library of the computer center of IIT. Professor Owen showed great interest in the application of his program to the field of psychology and assisted the writer of this dissertation in its use.

found in computer center libraries, this program contains many options and requires decision making at each stage in its application. The decisions are usually based on the results of the analysis obtained from previous phases of the program. In other words, the program must be run in sections and decisions must be made at each section of the run. The following is a summary of the phase operations.

Phase 1. Similarity or interaction coefficients are developed in the first run. Two decisions had to be made for this first run. The first decision required the determination of a match difference and a no match difference for each variable. What is meant here is that a band instead of a point is chosen as a threshold to determine when two variables are similar. The first threshold or "match difference" determines the band within which two variables must fall to be considered completely similar. The second, "no match difference", extends the first band to a partial match. If, for example, two variables fall within this band they will be considered partially similar, the degree depending upon how close they are to the first band.

The second decision determines the formula of the coefficient of similarity to be used in computing the similarity matrix. A discussion of this is found on page 16 of this dissertation. The coefficient of similarity chosen was $S = M/(M + U)$, which is the coefficient of Sokal and Michener (1958).

The primary purpose of Phase 1 is to provide information for the selection of a threshold for phase 2 of the program, the construction of a graph. To simplify the selection, all coefficients are charted on a histogram with 101 frequency classes from 0.00 to 1.00. The form of the display is designed to support a visual selection by inspection. Three factors should be balanced in selecting a threshold: (1) positions of "notches" in the histogram - these are natural separation points; (2) value of the chosen threshold coefficient - the higher the value, the more the discrimination; and (3) density of the resulting graph - higher coefficient values as thresholds implies sparser graphs with possible disconnected elements.

After some experimentation, it was decided initially to use one standard error of measurement for the match difference and two standard errors of measurements for the no match difference. The program was rerun using twice this value and then a third time using two standard errors of measurements for the match difference value and two standard deviations for the no match difference.

A punched deck of coefficients was produced by the program to be used as input data for the second phase.

Phase 2. In this phase the matrix of coefficients and a threshold are used to construct a nondirected graph. Elements to be linked are those whose coefficients are equal to or greater than the threshold value. The threshold value is determined by visual inspection of the histogram produced in phase one. Where elements are linked to no other, (no coefficient equal or above the chosen threshold), they are disconnected from the graph and listed with the highest value for a threshold that would allow them at least one link.

A matrix of coefficients is printed and a nondirected graph, (in an equivalent matrix form) developed using the threshold, is punched as a data deck in the proper format for input to phase three of the program.

Three runs of phase two were performed as an experiment to determine the best threshold value. The values at which they were run were .53, .51, and .48. This decision was made after the completion of phase three. This threshold value largely determines the size of the subgraphs, which result from the decomposition of the complete nondirected graph.

Phase 3. This phase of the program produces a decomposition of the graph under analysis into subgraphs. The program tries to sort out the best decomposition into subgraphs with complete linkage at the threshold chosen in phase two. By this is meant, every vertix in the graph has a connection, at the level of similarity selected, with every other vertix in that graph.

Two sets of subgraphs are determined by the program. The first is a disjunctive partition. In this partition an object can be included in only one of the subgraphs. The second is a nondisjunctive partition. Here an object can be included in more than one subgraph and as a result more subgraphs are produced than in the disjunctive decomposition.

The results are both printed and punched for use in phase four.

Phase 4. This phase of the program unites the various subgraphs produced in phase three. There are two different options in which the subgraphs can be united. The first is called a forced condensation whereas the second a natural condensation. In the forced condensation a definite number of the subsets of the disjunctive partition are selected and the rest are condensed into these. This produces the number of types equal to the number of subsets chosen. In the natural condensation, the subgraphs are united in levels until a complete graph is again produced. This can be accomplished by using either the disjunctive or the non-disjunctive subgraphs.

The results of the condensation are printed along with the amount of linkage uniting each level of the hierarchy. From this condensation, a tree graph can be drawn and the natural array of types and the hierarchical unity of the complete graph can be seen. The computer program does not actually draw this tree graph, its final stage merely supplies the information from which it can be drawn. Once the tree graph is constructed, the types can be easily determined and understood by anyone, after a brief orientation.

Both options, namely the forced and the natural condensation, were attempted and a taxonomy for each was determined.

5) Typing according to Rubin and Friedman using a similarity coefficient.

For the construction of the fifth taxonomy the program <u>A Cluster Analysis and Taxonomy System for Grouping Data</u> (Rubin & Friedman, 1967) was used. This program was obtained from the International Business Machines Corporation. It was then placed in the Loyola University Computer Center Library.

The program description (Rubin and Friedman, 1967) suggested that for optimum results the variables should be logically independent, i.e. one should not measure the same quantity several times. It also recommended that the variables be pertinent to the type of classification desired and limited in number. In order to meet this requirement it was decided to perform a factor analysis of the variables and use the factor scores as the data for the cluster analysis program. To perform the factor analysis the Biomedical Program BMD72X (Dixon, 1970) was used. The factor scores obtained from this program were in the form of z scores (mean = 0, standard deviation = 1). Since this would result in half of the scores being expressed as negative numbers, which would be impossible for the cluster program to handle, the z scores were transformed into T scores (mean = 50, standard deviation = 10). This was a trivial operation and performed by hand.

The cluster analysis program has many options, the following of which were chosen:

The type of variables was set for continuous and the standard option of mapping them into the interval (2, 255) by the transformation $x = 128 + N_{du}\left(\frac{X - M}{J}\right)$ was permitted. The format card was written in A-type (alphanumeric) form rather than F-type form as one would expect. The fractional match coefficient of Sneath and Sokal (Fractional match $S_{ij} = \frac{\text{Number of matches}}{\text{Number of variables}} = \frac{M}{N}$) was chosen for the formation of the similarity matrix. The lower limits of difference (the interval within which a match would be considered perfect) was placed as three. The upper limit of difference (the interval within which a match would be considered partial) was placed as eight. The breaking coefficient (S*) was selected as the average similarity coefficient. This is the standard option suggested for best results. The program was instructed to begin with a random partition of the data into 3 groups and the program was allowed to start with a hill-climbing pass. This is the standard option when starting from a random initial partition. Another option, instructing the program to use its own technique to find an initial partition, was tried. This, however, was unsuccessful. The program was further instructed to terminate after the standard value of 10 local maxima was reached. This, again, was the standard option suggested for normal use.

6) Typing according to Rubin and Friedman using a distance coefficient.

The program used for the construction of the sixth taxonomy was contained in the same package as that for the construction of the fifth taxonomy, <u>A Cluster Analysis and Taxonomy System for Grouping and Classifying Data</u> (Rubin and Friedman, 1967). This program likewise contains many options of which the following were chosen:

The factor scores obtained from the factor analysis of the variables used for the fifth taxonomy were used again. This program contains an option whereby the program itself will perform a principal component analysis of the data. This option was not used since a rotation to simple structure would not be performed and so it would be difficult to identify the variables used in the analysis if further research were to be conducted. The Mahalanobis' Generalized D^2 coefficient was chosen for the construction of the distance matrix. The program was instructed to terminate after the standard value of 10 local maxima was reached. This, again, was the standard option suggested for normal use. The program was also instructed to plot the final clusters of the data into the space of eigenvector one and two of the principal component analysis.

7) Discriminant analysis for testing the "goodness-of-fit".

A stepwise discriminant analysis was performed upon each of the above six taxonomies as a test for the goodness-of-fit. Nunnally (1967) defines and states the use of discriminant analysis as follows:

> Discriminant analysis is employed when groups of persons are defined a priori, and the purpose of the analysis is to distinguish the groups from one another on the basis of their score profiles... There are three related problems in discriminatory analysis, (1) deter-

> mining whether or not differences in score profile for two or more groups are statistically significant, (2) maximizing the discrimination among groups by combining the variables in some manner, and (3) establishing rules for the placement of new individuals into one of the groups.

It was for the first of these reasons that this analysis was chosen as a test for the goodness-of-fit. The analysis was performed with the Biomedical Program BMD07M (Dixon, 1967). All the computations were printed along with a summary table and the posterior probabilities. This information enables one to determine which cluster or type a subject belongs, in the event of a misclassification in the original taxonomy.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter will describe the results obtained from the analyses described in Chapter III, and will be divided into three parts following the outline set forth in the first chapter of this dissertation. The first part will treat the results of the intuitive taxonomy of Kennedy-Heckler; the second, the results of the two methods of factor analysis; and the third will present and discuss the results of the three forms of cluster analysis.

A. RESULTS ACCORDING TO AN INTUITIVE JUDGMENT

The Kennedy-Heckler intuitive taxonomy consisted of four types or clusters grouped according to a developmental scheme. The following summary table gives the results of how many subjects in the sample of 80 were classified into each type.

TABLE 8

Classification of subjects according to Kennedy-Heckler Taxonomy

TYPE	I	II	III	IV
Number of subjects	3	17	56	4

The first question to ask regarding this intuitive taxonomy seems to be, "Is the difference in score profiles for the four groups statistically significant?" This is the first of the three questions defined and stated by Nunnally (1967). A clarification of this is presented on page 71 of this dissertation. To answer this question a discriminant analysis was performed on the above types using the 27 variables described above in Part II of Chapter III, The Design of the Study. The summary results of the Biomedical Program BMD07M are presented in Table 9. Each row and each column of the matrix display represent a type of the taxonomy which was initially inputed into the discriminant analysis program. The table is read by rows, one row for each type of the taxonomy. The diagonal entries of the matrix represent the correct classification. The other entries in the row, if there are any, represent misclassifications, whose proper classification would be that type, in which column it appears.

TABLE 9

Summary table of Discriminant Analysis of the Kennedy-Heckler Taxonomy

TYPE	I	II	III	IV
I	3	0	0	0
II	1	16	0	0
III	1	10	42	3
IV	0	0	0	4

Inspection of Table 9 shows that 15 of the 80 subjects were misclassified according to the discriminant analysis. One subject of the second type was misclassified; this subject belonged to the first type. Fourteen subjects of the third type were also misclassified; one of these belonged to the first type, ten to the second type and three to the fourth. All subjects in type one and four were classified correctly. In summary, then, 18.5% of the 80 cases were misclassified according to the discriminant analysis.

The most likely reason for this misclassification could be a difference between the clinical and psychometric data, the clinical being used for the taxonomy and the psychometric for the discriminant analysis. Care was taken in the original design of the study to assure that the results of the clinical and psychometric reports would be similar. An examination of the section on Apparatus, Chapter III, should confirm this. Another possible explanation might be that when Kennedy-Heckler made their judgments for classifying the subjects, they were not able to make these (a) on the same variables for each subject or (b) to give equal weightto each variable involved in these judgments. One must admit, however, that the results are rather remarkable.

B. RESULTS ACCORDING TO FACTOR ANALYSIS

As outlined in the introductory chapter of this dissertation, a factor analysis was performed upon two types of coefficients. The first is called Cattell's Q technique and uses a correlation coefficient. The second type is called Nunnally's sum of cross-products and employs a covariance coefficient. The results of each type will be presented followed by a brief discussion concerning the differences found in each analysis.

1. Cattell's Q Technique.

As stated above (page 61, cf. Harman, 1967, pp 137-146), the minimum eigenvalue for which the factors would be computed was set at .50. The results are presented in Table 10.

TABLE 10

Unrotated Factor Matrix.

Factors above .50	I	II	III	IV
Eigenvalue	76.160	1.342	.708	.642
Percent of Variance	95.2	1.6	.9	.8

These factors were then rotated to simple structure. The summary results of this rotation are presented in Table 11. Four types with 70, 5, 3 and 2 subjects respectively were obtained. The actual rotated matrix has been reproduced in Appendix A.

TABLE 11

Classification of Subjects

Factors (types)	I	II	III	IV
Number of subjects	70	5	3	2

For all practical purposes this analysis is useless, since 70 out of the 80 subjects were classified in the first factor or type.

2. Nunnally's Sum of Cross Products Technique.

The number of factors to be extracted and rotated was set at ten (cf. page 63). More than 10 usable types were not expected to be found. In any event, it was arbitrarily decided before-hand to discard any factor that contained less than five subjects, since by definition one could hardly call this a general type. The results of the analysis are presented in Table 12

TABLE 12

Unrotated Factor Matrix

Factors	I	II	III	IV	V	VI
Eigenvalue	4802.3	1727.0	1092.6	824.2	576.9	449.4
% of variance	37	15	8	6	5	4
Factors	VII	VIII	IX	X		
Eigenvalue	459.4	347.1	322.1	288.6		
% of variance	3	3	2	2		

These factor scores were likewise rotated to simple structure as was done for the Cattell Q Technique. The summary results are presented in Table 13.

TABLE 13

Classification of Subjects

Factor (type)	I	II	III	IV	V	VI
Number of subjects	37	7	6	9	6	3
Factor (type)	VII	VIII	IX	X		
Number of subjects	2	6	3	1		

Since the limits for usable types were set at 5 (cf. p. 77) Factors VI, VII, IX and X were not used. Therefore 71 of the 80 subjects were classified into the other six types. The first type contained 37 subjects which accounted for 37% of the variance as opposed to the Cattell analysis where the first type included 70 subjects accounting for over 95% of the variance. The other five types contained 34 subjects accounting for 41% of the variance whereas the other three Cattell types contained 10 subjects which accounted for only 3.3% of the variance. The first factor for the Nunnally analysis, as would be expected, did contain a large proportion of the subjects but this was less than half of the original number. It can only be concluded that at face value the Nunnally analysis appears to be a great improvement over Cattell's Q Technique.

The question however that must still be asked, "Is the classification a true classification and have the subjects been properly classified into homogeneous groups according to the variables upon which the classification was made?" A discriminant analysis was performed to test the validity of the classification. A discriminant function was computed for each type and the data were then classified as follows according to these functions. The results are presented in Table 14 and seem to be significant. This table, as well as the other summary tables of discriminant analyses which follow, is interpreted as explained above, page 74 .

TABLE 14

Summary table of Discriminant Analysis of
Nunnally's Taxonomy

TYPE	I	II	III	IV	V	IV
I	37	0	0	0	0	0
II	0	7	0	0	0	0
III	0	0	6	0	0	0
IV	0	0	0	8	1	0
V	0	0	0	0	6	0
VI	0	0	0	0	0	6

As can be seen only one subject was misclassified according to the discriminant analysis. This subject belonging to Type IV should have been placed into Type V.

From these results it seems that one must admit the validity of Nunnally's criticism of Cattell's Q Technique. In Cattell's taxonomy 70 out of 80 subjects were classified in the first type, which contained 95% of the variance. This classification is useless since it produces practically no new order in the data. Nunnally's taxonomy, however, is distributed over six usable types. This distribution on the other hand especially since it contained only one misclassification, adds real scientific order to the data. The reason for the discrepancies between the two methods probably has to do with the scales that were used, especially the Personal Orientation Inventory. This test was constructed to measure self-actualization. This is indicated according to the level of the scale, a more self-actualized person being higher and a less self-actualized person lower on the scale. The Cattell's Q Technique, however, is unable to detect or differentiate this kind of information (cf. pp. 7 ff.). As a result, much of the discrimination of the technique was lost. In counter-distinction, Nunnally's technique, since it is able to use this kind of information in its differentiation of types, obtained a much better discrimination of types.

C. RESULTS ACCORDING TO CLUSTER ANALYSIS

Three different types of cluster analysis were performed upon the data. The first two types used a similarity coefficient to form a matrix upon which the cluster analysis was performed. The first similarity matrix was then built into a nondirected graph and decomposed according to Owen's algorithm. The second type of similarity matrix was clustered according to the Rubin-Friedman hill-climbing algorithm. The third type of cluster analysis used Mahalanobis' generalized D^2 coefficient to form a distance matrix. The results of this matrix was clustered according to the Rubin-Friedman hill-climbing algorithm. The results along with a brief discussion of these three analyses are presented in the following three sections.

1) Owen's Graph Method.

As was explained in Chapter III (cf.,page 64) several decisions had to be made concerning Phase I of Owen's program. The primary decision concerned the setting of the limits of matched and no-matched differences, cf. page 65 . The first run set the limits at one and two standard errors of measurement respectively. The results of this run were printed in the form of a histogram which can be seen in Appendix C, page 125. A visual inspection of this histogram reveals that the setting of the bond between matched and no matched difference was too narrow and did not produce enough similarity from which a decent non-directed subgraphs could be produced. The average similarity was only .178. A second run was tried using twice this value. The results improved as can be seen from the histogram found in Appendix C, page 126. This band, however, was still too small. A third run was attempted, this time using two standard errors of measurement as the matched difference and two standard deviations as the no-matched difference. The results produced a histogram which showed an average similarity of .426 which Owen (personal communication) considered suitable for the construction of a nondirected graph.

Three threshold points of similarity on the third histogram were chosen as breakoff points for the decomposition of the nondirected graph into subgraphs. The first was .53, the second .51, and the third .48. The first threshold value produced a disjunctive partition of 39 sets or subgraphs. There were two subgraphs which contained 4 subjects, eleven with 3 subjects, ten subgraphs with 2 subjects and fifteen subgraphs with only one subject. The second threshold value, .51, produced 34 sets with eight subgraphs containing 4 subjects, six subgraphs containing 3 subjects, nine subgraphs containing 2 subjects and eleven subgraphs with only one subject. The results of both of these decompositions were considered too dense with the resulting subgraph too sparse and disconnected. If a condensation were attempted, more than likely too many distinct types would appear, thereby producing little scientifically intelligible order in the data.

A third run was tried, this time using .48 as a cutoff threshold. The decomposition produced two sets of subgraphs. The first was a disjunctive partition of 25 sets. In this disjunctive decomposition there were three subgraphs containing 6 subjects, four subgraphs containing 5 subjects, three subgraphs containing 4 subjects, five subgraphs containing 3 subjects, five subgraphs containing 2 subjects and five subgraphs containing only one subject. A nondisjunctive partition was also performed. This contained 37 sets, in which eight subgraphs contained 6 subjects, nineteen subgraphs contained 5 subjects, eight subgraphs contained 4 subjects, one subgraph contained 3 subjects and one subgraph with two subjects.

From the results of these two decompositions three types of condensation were performed. The first was a forced condensation where the seven largest subsets of the disjunctive partition were used as seed sets and the remaining 18 subsets were condensed into these. Seven types resulted with ten subjects in the first type, fourteen subjects in the second, fifteen subjects in the third, fourteen subjects in the fourth, fourteen subjects in the fifth, eleven subjects in the sixth and ten subjects in the seventh. As can be seen from the totals, 8 subjects were classified in more than one type.

A discriminant analysis was performed on this taxonomy for determining its goodness-of-fit. The results of this analysis appear in Table 15.

TABLE 15

Summary Table of Discriminant Analysis of Owen's Forced Condensation

Type	I	II	III	IV	V	VI	VII
I	10	0	0	0	0	0	0
II	0	6	1	2	2	0	3
III	0	1	10	2	2	0	0
IV	1	2	0	10	1	0	0
V	0	0	0	1	10	0	3
VI	2	1	1	0	0	7	0
VII	0	1	0	0	0	0	9

Inspection of this table shows that 26 of the subjects were misclassified or, in other words, 29% of the cases. Eight subjects were misclassified in type II, five subjects in type III four subjects in type IV, four subjects in type V, four subjects in type VI, and one subject in type VII.

The second condensation that was performed was a natural condensation (cf. p. 67). The subjects were united into levels in a hierarchical manner until a complete graph was again produced. This was first performed using the disjunctive partition. The results of this condensation are displayed in the

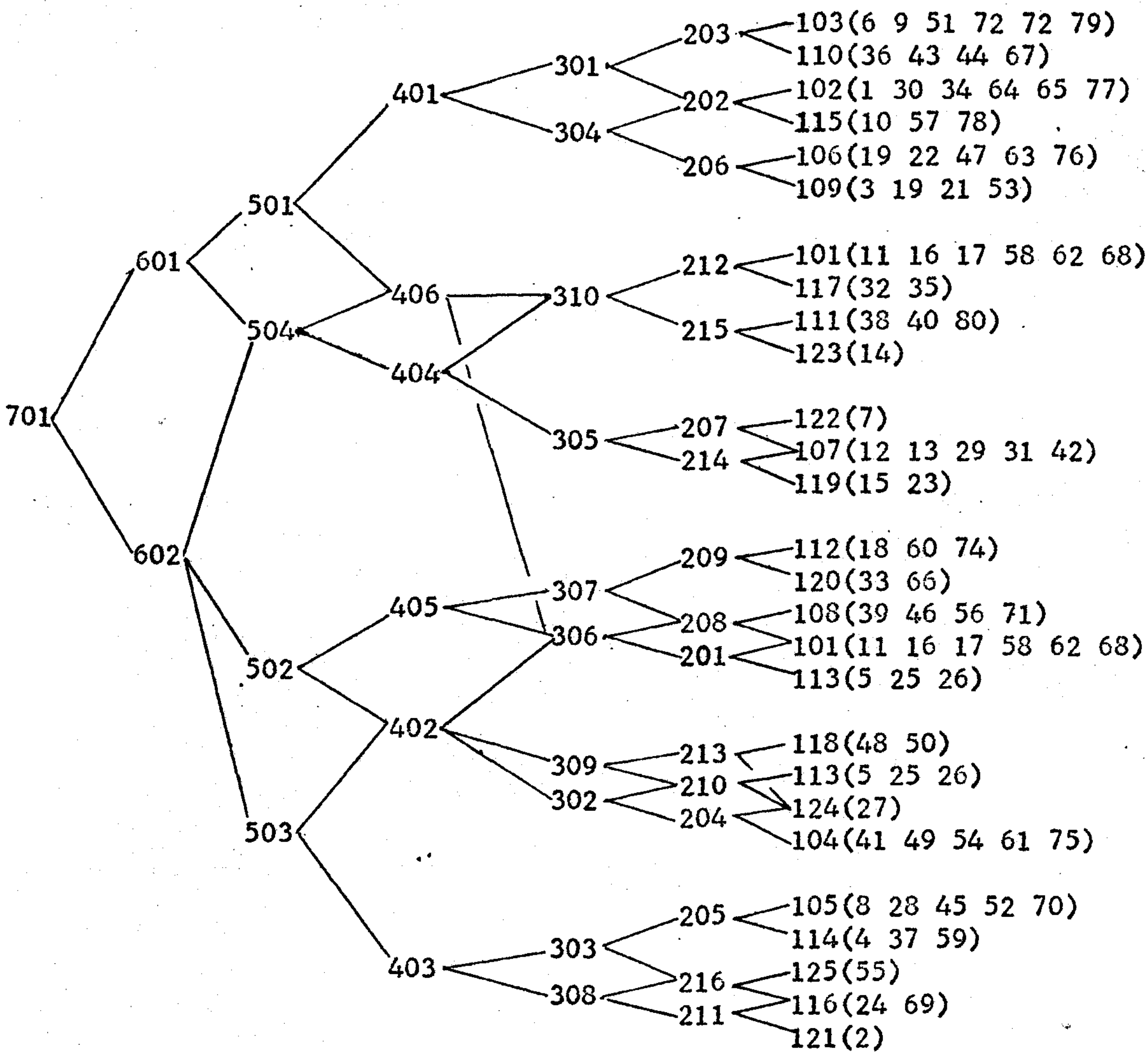


TABLE 16

Dendogram for Owen's Disjunctive Partition form of a dendrogram or tree graph in Table 16. The types can be determined by visual inspection of the dendrogram. Five types resulted with twenty eight subjects in the first, eight in the second, eighteen in the third, nine in the fourth and eleven in the fifth. What would appear as the second type, is partially contained in type III and since the linkage is weak it was excluded from the taxonomy.

A discriminant analysis was likewise performed on this taxonomy. The results of the analysis appear in Table 17.

TABLE 17

Summary Table of Discriminant Analysis of Owen's Natural Disjunctive Condensation

TYPE	I	II	III	IV	V
I	15	3	6	2	2
II	0	7	0	0	1
III	2	0	16	0	0
IV	2	1	0	6	0
V	0	2	0	1	8

Inspection of this table shows that 22 subjects were misclassified or, in other words, 30% of the subjects. Thirteen of these subjects were in type I, one in type II, two in type III three in type IV and three in type V.

A second natural condensation was also performed, since the program produced two types of partitions (cf. p. 67. phase 3). This time the nondisjunctive partition was used for the condensation. The results of this condensation can be seen in Table 18. This again is displayed in the form of a dendrogram and the types can again be determined by visual inspection of the dendrogram. As can be seen from Table 18, a subject in a nondisjunctive graph can be classified in more than one type. Eight types appear in the dendrogram, which include 120 entries. This large number of entries resulted from the fact that a subject could be classified into more than one type. Several subjects were even classified into more than three types.

A discriminant analysis was likewise performed on this taxonomy. The results of this analysis appear in Table 19.

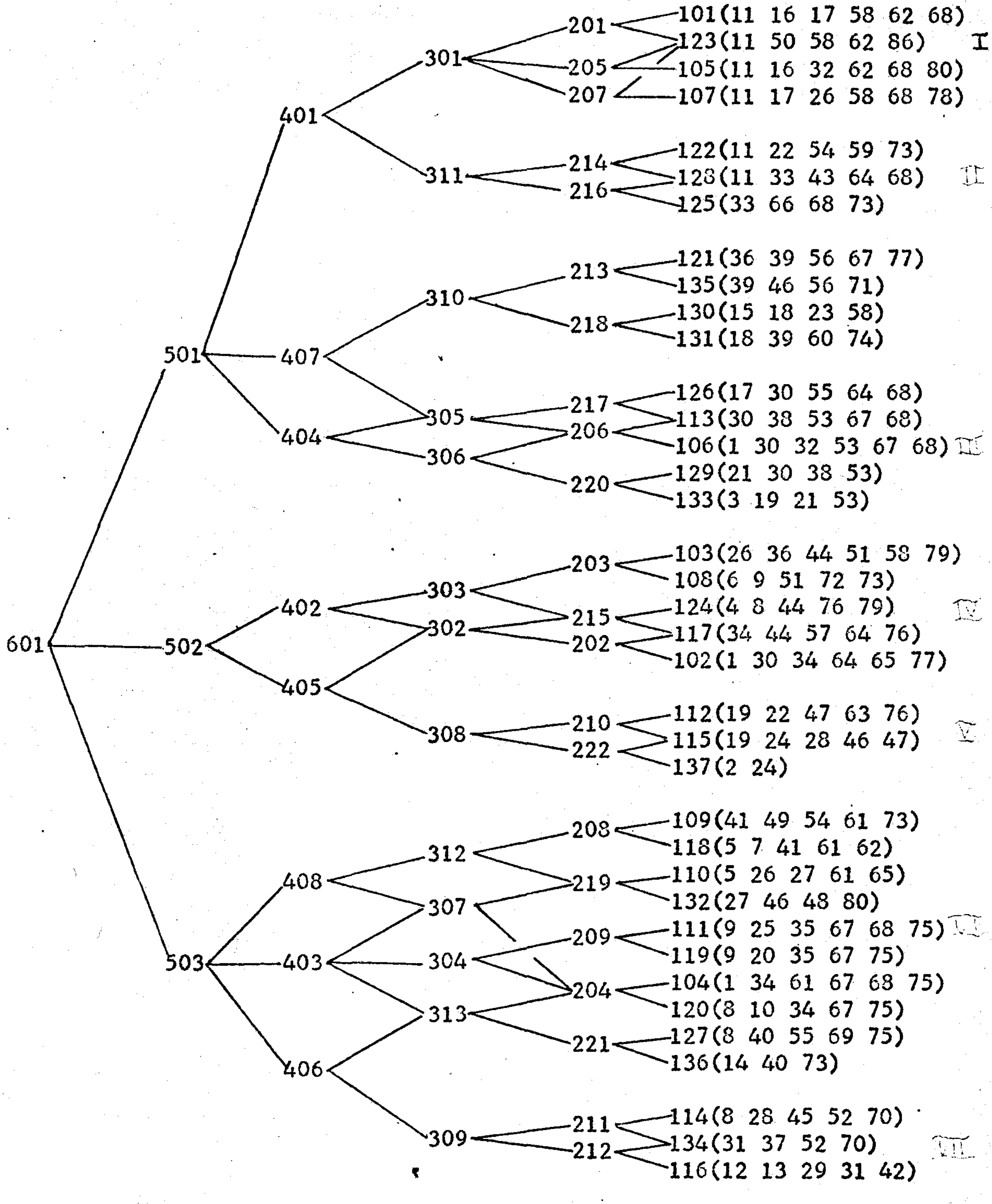


TABLE 18

Dendrogram for Owen's Non-disjunctive Partition

TABLE 19

Summary Table of Discriminant Analysis of Owen's Natural Non-disjunctive Condensation

TYPE	I	II	III	IV	V	VI	VII	VIII
I	6	1	1	1	0	0	1	1
II	0	6	1	0	1	0	2	0
III	0	1	5	1	1	2	1	2
IV	2	2	0	11	1	3	1	0
V	0	0	0	0	7	0	0	1
VI	1	1	0	3	1	9	4	0
VII	2	2	1	2	1	9	12	0
VIII	0	0	0	1	0	0	0	10

Inspection of this table shows that there are 55 misclassified subjects. This is 46% of the subjects. Five of these were in type I, four in type II, eight in type III, nine in type IV, one in type V, ten in type VI, 17 in type VII, and one in type VIII.

At first sight, the results of this taxonomy seem very poor. However, there are several points to remember. The first point that must be kept in mind is that the condensation was made from a nondisjunctive partition of the original nondirective graph. This means that a subject can appear in more than one subgraph. Therefore, when the subgraphs are condensed into a dendrogram from which the types are determined, it is possible for a subject to be found in more than one type. The discriminant analysis, however, will not allow a subject to be classified into more than one type. Close examination of the table of posterior probabilities for each group indicates that in all but 8 cases, the misclassification is not actually a misclassification of the subject but a result of the overlapping due to the nondisjunctive partition which by definition means a subject can appear in more than one subgraph. An inspection of the posterior probabilities as found in Appendix C, page 130 will show this. As can be seen in the table, in all but 8 cases where the subject appeared in more than one type because of the nature of the disjunctive partition, the discriminant analysis chose one of these and consistently referred the others to it. In view of these considerations then, only 10% of the subject were actually misclassified. This is considerably better than the initial observation of a 46% misclassification.

5) The Rubin-Friedman method with a similarity coefficient.

Before the Rubin-Friedman cluster analysis program could be run, the variables had to be factor analyzed. One of the problems in factor analysis has always been the determination of the number of usable and meaningful factors. The rule established by Harman (1967) was followed. "The number of common factors should be equal to the number of eigenvalues greater than one..." This usually runs from a sixth to a third of the total number of variables. Six factors were found to fit this criterion. The factor scores from these six factors for each subject were the variables used for the cluster analysis. The rotated factor matrix and the factor scores can be found in Appendix D, page 136.and 137f.

Using these variables for the Rubin-Friedman method, five groups, or types, resulted. The first type contained thirty-five subjects, the second type contained ten subjects, the third type contained nine subjects, the fourth type contained twenty-one subjects and the fifth type contained five subjects.

A table describing the stability and instability of the subjects was contained in the computer printout. This is reproduced in Appendix D, page 141. The following is the criterion upon which this was based. An object was classified stable if the "within" similarity is larger than the splitting function (S*) and the "between" similarity less than this value. Twenty five of the subjects were found unstable. Examination of the table of average similarity, also reproduced in Appendix D, page 139, shows that eight of the twenty five subjects actually had a within similarity closer to another type than the type in which it was actually classified. In the other seventeen cases the "between" similarity was very close to the "within" similarity. This is an indication that the types obtained by the program were not very well structured.

A discriminant analysis was then run on these results. The summary table of this analysis is reproduced in Table 20.

TABLE 20

Summary Table of Discriminant Analysis of the Rubin-Friedman Cluster Program Using a Similarity Coefficient.

TYPE	I	II	III	IV	V
I	24	3	5	3	0
II	0	7	0	1	2
III	0	3	4	1	1
IV	7	2	2	9	1
V	0	0	1	0	4

Inspection of this table shows that 32 subjects were misclassified by this cluster program. This is 40% of the cases. Eleven subjects of type one were misclassified; three of type two; five of type three; twelve of type four; and one subject of type five.

A comparison of the posterior probabilities contained in the discriminant analysis and the table of stable and unstable cases in the cluster analysis printout did not show any agreement or pattern between the misclassified subjects of the discriminant analysis and the unstable subjects of the cluster program. Fifteen out of twenty five of the unstable subjects were misclassified by the discriminant analysis while ten of the unstable subjects were classified correctly according to the discriminant program. Seventeen of the stable subjects were misclassified by the discriminant analysis. This can be seen from an examination of the tables reproduced in Appendix D. It is difficult to account for these discrepancies except to state that the cluster analysis program did not produce very faithful types.

6) Rubin-Friedman method using a D^2 coefficient.

The factor scores used as data input for the last analysis were also used in running the Rubin-Friedman cluster analysis program using a D^2 coefficient. This program found six clusters or types. There were 27 subjects contained in the first type, 12 subjects in the second, 6 in the third, 22 in the fourth, 12 in the fifth and 8 in the sixth type.

An examination of the tables containing the pooled scatter matrix and the weighted distance between each subject and each group reproduced in Appendix E (cf. p. 145 and 146f.) shows that there is a great contrast between the "within" and the "between" distances. These results are displayed graphically in the "Plot of Objects in the Space of Eigenvectors One and Two." This plot has also been reproduced in Appendix E. (cf. p. 148) An examination of this plot shows six clearly defined types.

A discriminant analysis was next run on these six types in order to test their "goodness-of-fit." The results of this analysis have been reproduced in Table 21.

TABLE 21

Summary Table of Discriminant Analysis of the Rubin-Friedman Cluster Program Using Mahalanobis' D^2 Coefficient.

TYPE	I	II	III	IV	V	IV
I	20	0	0	0	0	0
II	0	12	0	0	0	0
III	0	0	6	0	0	0
IV	0	0	0	22	0	0
V	0	0	0	0	12	0
VI	0	0	0	0	0	8

An examination of Table 21 shows that there are no misclassified cases. In other words, the method produced a perfect classification. This is what would be expected from the examination, explained above p. 95, concerning the tables containing the pooled scatter matrix (cf. Appendix E, page 145), and the plot of the clusters on the first two eigenvectors (cf. Appendix E, page 148).

CHAPTER V

SUMMARY AND CONCLUSIONS

The purposes of this study were to investigate and explore the various methods by which a taxonomy of personality adjustment could be constructed and to introduce numerical taxonomy as a possible alternative to the models used at present. The actual hypotheses tested were as follows:

I. Anyone of three models, namely an intuitive judgment, factor analysis and cluster analysis, is as good as any other for the purpose of forming ideal personality types.

II. Within the factor analytic model, the results obtained by using a matrix constructed with a correlation coefficient do not differ from the results obtained by using a matrix constructed with a covariance coefficient.

III. Within the cluster analytic model, the results obtained by using a matrix constructed with a similarity coefficient do not differ from the results obtained by using a matrix constructed with a distance coefficient.

In order to test these hypotheses, the following six methods were examined and compared. A summary of the results of this examination follow.

A. Cattell's Q Technique. This method used a correlation coefficient to form a matrix from which it extracted the personality adjustment types by means of factor analysis. This method produced four types. Seventy out of 80 of the subjects, however, or 87.5% of the cases, were classified in the first type. Since this adds almost no scientific order to the data, it was considered useless for our purpose.

The defect of the method seems, to a great extent, to be due to the variables used in the study. There are two reasons for this statement. First the variables were of a continuous type. Continuous variables contain three important sources of information in the profile of scores for any person, namely the level, the dispersion and the shape. In forming the correlation coefficient, the score on each variable is standardized (cf. $r = \frac{\sum z_y z_x}{N}$). This standardization reduces the mean (level) to zero and the standard deviation (dispersion) to one for each of the scales. Because of this, two main sources of discrimination, level and dispersion were lost when the scores were standardized. For the Cattell method, therefore, the entire discrimination of types was made in the single source of information, namely, the shape. Second, in the particular variables used in this study, especially the Personality Orientation Inventory, the level probably contains the most important source of discrimination. For example, the POI was constructed to measure self-actualization. This is indicated according to the level of the scale, a more self-actualized person being higher and a less self-actualized person lower on the scales. Without this important source of discrimination, one would expect the poor results which actually were obtained.

Two other less successful methods seem to be the two cluster analytic techniques which used a similarity coefficient to form their input matrix.

B. Owen's Graph Method. The first of the two methods which used a similarity coefficient was Owen's graph method (cf. pp. 63 ff.) The three different options contained in the program were used, namely; a forced condensation using a disjunctive partition of the original graph formed from the similarity matrix, a natural condensation using first the same disjunctive partition and a natural condensation using a non-disjunctive partition of the original graph. The first of these options produced seven types. When a discriminant analysis was performed on these results, however, it was discovered that 26 of the subjects or 32.5% of the cases were misclassified. The second option produced five types.

Here again, however, when a discriminant analysis was performed on these results, 22 subjects or 27.5% of the cases were found to be misclassified. The third option produced eight types. Although at first sight it seemed that according to a discriminant analysis performed on the results, 55 subjects were misclassified, when the posterior probabilities of the discriminant analysis were examined, this large number of misclassifications proved to be due to the nature itself of the non-disjunctive partition (cf. p 90 f.). If this is taken into consideration, then only eight subjects were misclassified, or 10% of the cases.

C. <u>Rubin-Friedman Method Using A Similarity Coefficient</u>. The second cluster analytic method using a similarity coefficient was that of Rubin-Friedman. It produced a taxonomy of five types. A discriminant analysis was performed on these types. Thirty two subjects or 40% of the cases were found to be misclassified.

From the probability standpoint, concerning a statistical method, the percent of misclassifications seem to be high, except for Owen's natural condensation of a non-disjunctive partition. The fact that both cluster methods, that of Owen using a decomposition of a nondirective graph and that of Rubin-Friedman using a hill climbing method to maximize a function, obtained such poor results leads one to suspect that it is not the cluster method as such, but rather the coefficient, which was the same for both methods, that caused these poor results. This coefficient, briefly described in the Review of the Literature (cf. pp. 21 ff.) was first developed for use with discrete variables. This is the type of variable used primarily in the fields of biology and architecture. The similarity coefficient was developed in place of Mahalanobis' D^2 cofficient by these disciplines since most of the variables are discrete and a distance cannot be properly measured between two discrete variables. At first this similarity coefficient could not be used for continuous variables because there were too many possibilities of a mismatch, and a high number of mismatches would not produce enough similarity to cause a discrimination of types. This difficulty, however, was later overcome (cf. pp. 17 ff.) by the use of a band for the match and no-match difference. It would appear, however, that for the type of variables contained in the psychometric measurements used in this study, this adjustment was not sufficient.

D. Kennedy-Heckler Intuitive Method. The fourth method of taxonomy was the intuitive method of Kennedy-Heckler. They found four different types which were constructed along a developmental continuum (cf. pp. 59 ff.). Fourteen subjects or 17.5% of the cases were misclassified according to the discriminant analysis performed on the results of this taxonomy. From a judgmental standpoint, this is quite good, but from the standpoint of statistical probability, it is not so good. Some of this misclassification might have resulted from the fact that two different sources of data were used, clinical data in the construction of the taxonomy and psychometric data in the discriminant analysis. An attempt was made in the design of the study to duplicate the results of each data collection method, but this is almost impossible to accomplish. There is also the considerable difficulty in weighting the same variable equally in each of the intuitive judgments. This difficulty could also be reflected in the results of the discriminant analysis.

E. Nunnally's Sum of Cross Products Methods. This method used a covariance coefficient to form a matrix from which it extracted the types by means of factor analysis. This factor analysis obtained six different clusters or types. The results when compared with those of Cattell, are remarkable. First, there appears to be a better distribution of subjects in the Nunnally analysis than in the Cattell's Q Technique. For Nunnally's method the first factor contained 35 subjects or 44% of the cases in counter-distinction to Cattell's first factor which contained 70 subjects or 88% of the cases. Second, the discriminant analysis on the Nunnally results was also quite remarkable, especially in comparison with the other methods, either using a correlation coefficient or a similarity coefficient. For Nunnally's method there was only one misclassification out of 71 subjects or, in other words it classified 98.75% of the cases correctly. The reason for this seems to be attributable to the fact that a covariance coefficient, since it is merely a cross product which does not standardize the scales, was able to preserve not only the shape of the variable but also its level and dispersion. These two added sources of differentiation, in turn, seems to have provided a wider foundation for discrimination. (cf.pp.7 ff.)

F. Rubin-Friedman Method Using a D^2 Coefficient. The sixth and last method attempted in this study was that of Rubin-Friedman using a distance coefficient, Mahalanobis' D^2. This program produced a taxonomy containing six different types. The discriminant analysis performed on these results found no misclassified cases. In other words, this method performed a perfect classification. If one examines closely how a distance coefficient is formed, an interesting fact results. The formula for D^2_{ij} is $(x_i - x_j)^2 + (y_i - y_j)^2$. Actually this is a kind of covariance measurement. Another interesting fact is that only the two methods which used a covariance coefficient were able to obtain a perfect or near perfect classification of types according to the discriminant analysis performed on the results obtain for each method. This seems to be due to the fact that only the covariance coefficience was able to preserve all three sources of discrimination, namely, the level, dispersion and shape (cf. pp 7 ff.).

On the basis of these results, the following conclusions seem to follow:

1. There are various methods by which a taxonomy can be constructed. From the results obtained in this investigation the basic models of factor analysis and cluster analysis seem to be somewhat superior to an intuitive judgment. Using the discriminant analysis as a criterion, the Rubin-Friedman cluster analysis using Mahalanobis' D^2 coefficient obtained a perfect classification, the Nunnally factor analysis obtained a 98.8% correct classification, whereas the Kennedy-Heckler intuitive method obtained only a 81.5% correct classification. From this it follows that the first hypothesis suggested in this study must be rejected. The three models were not equally effective in forming ideal personality types.

II. Within the same basic model there was even a greater difference than that found between the models.

a. Within the factor analytic model, although the Nunnally method obtained an almost perfect classification (98.8%), the Cattell method proved to be useless with 80% of the cases classified in the first type. From this it follows that the second hypothesis purposed for this study must also be rejected. Within the factor analytic model, the results obtained from a covariance coefficient were superior to those obtained from a correlation coefficient.

b. The same phenomenon was found again within the cluster analytic model. The Rubin-Friedman method using Mahalanobis' D^2 coefficient obtained a perfect classification. Owen's method and the Rubin-Friedman method using a similarity coefficient, however obtained less satisfactory results. The Owen method misclassified between 10-30% of the cases whereas the Rubin-Friedman method using a similarity coefficient misclassified 40% of the cases. From these results it follows that the third hypothesis must also be rejected. Within the cluster analytic model, the results obtained from using a distance coefficient were superior to those obtained from using a similarity coefficient.

III. From these conflicting results within the same model (cf. Conclusion II), it appears that the type of variable used in the study seems to be the most important factor in determining the results that were obtained from the three basic models For the variables used in this study: that is, the type obtained from the commonly used psychometric personality inventories, the method which used a covariance coefficient matrix obtained the best results. That is, both the factor analytic method and the cluster analytic method which used a covariance coefficient proved superior to all others. The reason for this seems to be that the psychometric measurements used in this study all contained three basic components of discrimination: namely, level, dispersion and shape. Only the covariance coefficient, however, was able to preserve all three of these dimensions (cf. p. 8 f.).

IV. It would seem that future studies should use more care in determining the variables in view of the type of analysis envisaged. Although the results of this study seem to indicate that for psychometric measurements commonly used in psychology, a covariance coefficient obtained best results, other studies are now needed to determine which coefficients would obtain best results for the type of measurements peculiar to other disciplines. Until this is accomplished, it seems that the confusing results pointed out in the third section of the review of the literature (cf. p. 37) will be hard to unravel.

V. Another consideration, by way of postscript, that could easily influence the choice of methods would seem to be the availability of computer facilities. Although the results of the two methods which used covariance coefficients were best, the amount of computer time for their execution was very different. The execution of Nunnally's factor analysis took 13.52 minutes whereas the Rubin-Friedman cluster analysis took 140.28 minutes. The Northwestern University Computer Center charged $9.00 a minute in 1970 for the use of their computer. At this rate, Nunnally's program would cost $121.68 for execution whereas the Rubin-Friedman cluster analysis would cost $1,262.52. Although

Nunnally's program did not classify all the cases, still there is considerable difference in the price and this difference should be kept in mind in determining the design of any study.

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APPENDIX A

Computer Printouts for the Cattell's Q Technique Method

ROTATED FACTOR MATRIX

CATTELL'S Q TECHNIQUE

VARIABLE	FACTOR 1	2	3	4
1	-0.73082	0.45582	-0.39837	-0.31042
2	-0.47940	0.34079	-0.75072	-0.22689
3	-0.54500	0.56419	-0.38847	-0.46880
4	-0.78752	0.35223	-0.44443	-0.22579
5	-0.73241	0.43753	-0.40470	-0.31996
6	-0.74532	0.42512	-0.40404	-0.31199
7	-0.74971	0.39792	-0.42070	-0.31545
8	-0.76265	0.39033	-0.40374	-0.29551
9	-0.68882	0.54529	-0.36268	-0.28786
10	-0.72598	0.41706	-0.39851	-0.34305
11	-0.68428	0.52528	-0.37386	-0.31017
12	-0.78219	0.38423	-0.39683	-0.28014
13	-0.55060	0.62114	-0.31488	-0.44947
14	-0.35739	0.40859	-0.56348	-0.60395
15	-0.76190	0.42481	-0.41972	-0.24566
16	-0.75001	0.51571	-0.24703	-0.31417
17	-0.72338	0.47235	-0.43594	-0.22964
18	-0.60126	0.51910	-0.45731	-0.37804
19	-0.73740	0.44628	-0.37853	-0.33315
20	-0.72934	0.35668	-0.37708	-0.43028
21	-0.56674	0.53230	-0.54215	-0.27595
22	-0.69318	0.26181	-0.40505	-0.52792
23	-0.79153	0.40995	-0.37736	-0.23345
24	-0.76977	0.36179	-0.30614	-0.39526
25	-0.77173	0.35244	-0.27690	-0.43069
26	-0.66155	0.50558	-0.43028	-0.34629
27	-0.59613	0.51362	-0.43839	-0.40715
28	-0.73679	0.40305	-0.39819	-0.36471
29	-0.69916	0.40404	-0.41712	-0.37937
30	-0.56619	0.51670	-0.46188	-0.44234
31	-0.73757	0.44162	-0.41071	-0.29867
32	-0.75459	0.43586	-0.35244	-0.32177
33	-0.40840	0.56696	-0.58909	-0.37162
34	-0.64283	0.58397	-0.33199	-0.35995
35	-0.75164	0.36616	-0.43114	-0.31908
36	-0.74869	0.45802	-0.34848	-0.32469
37	-0.75093	0.46094	-0.35607	-0.29763
38	-0.58976	0.35797	-0.50295	-0.42316
39	-0.71522	0.39543	-0.28067	-0.49592

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2.

40	-0.65317	0.41313	-0.47070	-0.39707
41	-0.77359	0.38950	-0.42040	-0.25558
42	-0.75303	0.48262	-0.29602	-0.31384
43	-0.74342	0.41803	-0.42325	-0.30216
44	-0.73914	0.37406	-0.47464	-0.28232
45	-0.76039	0.37765	-0.43007	-0.29795
46	-0.64075	0.37164	-0.39242	-0.50323
47	-0.66387	0.50489	-0.44959	-0.30792
48	-0.80999	0.32566	-0.17582	-0.44021
49	-0.74733	0.39206	-0.45120	-0.27668
50	-0.74408	0.45895	-0.36096	-0.31642
51	-0.73490	0.38632	-0.40227	-0.36464
52	-0.75842	0.32496	-0.44575	-0.32291
53	-0.70435	0.47827	-0.35515	-0.37300
54	-0.56735	0.52268	-0.53473	-0.30885
55	-0.73561	0.42653	-0.44427	-0.27583
56	-0.72825	0.44606	-0.37175	-0.35945
57	-0.67847	0.42642	-0.46032	-0.34540
58	-0.76146	0.37927	-0.32973	-0.39907
59	-0.63197	0.49601	-0.30448	-0.49754
60	-0.59361	0.56256	-0.49001	-0.28536
61	-0.61172	0.51659	-0.42809	-0.41507
62	-0.78115	0.37065	-0.31986	-0.37504
63	-0.49936	0.45650	-0.60313	-0.39256
64	-0.72426	0.46237	-0.38985	-0.32297
65	-0.70399	0.48564	-0.37695	-0.35163
66	-0.49192	0.68302	-0.34795	-0.33388
67	-0.69211	0.30241	-0.49025	-0.41135
68	-0.75553	0.28443	-0.45051	-0.37095
69	-0.67610	0.48455	-0.47347	-0.27811
70	-0.74264	0.38173	-0.40733	-0.35783
71	-0.55012	0.63022	-0.44609	-0.30026
72	-0.73605	0.43499	-0.37249	-0.35346
73	-0.66338	0.45980	-0.39051	-0.42123
74	-0.34060	0.56802	-0.26276	-0.68985
75	-0.64018	0.45871	-0.52230	-0.30597
76	-0.76707	0.40344	-0.42232	-0.24041
77	-0.34469	0.82309	-0.27367	-0.22978
78	-0.77218	0.42415	-0.38530	-0.27308
79	-0.60367	0.48637	-0.55358	-0.28731
80	-0.84538	0.39765	-0.28408	-0.16528
	70	5.	3	2

APPENDIX B

Computer Printouts for Nunnally's Sun of Cross Products Method

3.

OTATED FACTOR MATRIX NUNNALLY'S SUM OF CROSS PRODUCTS. METHOD

	VARIABLE	FACTOR 1	2	3	4	5	6	7	8	9	10
10504013	1	12.09711	-2.56167	4.47950	6.39578	-0.27510	-4.70179	2.28538	1.10836	-2.39522	0.47916
10504014	2	-6.07653	-2.36071	-14.82377	-1.67939	0.25719	0.73862	0.38861	-0.68123	-0.67118	-0.66976
10504017	3	2.67227	2.23562	-3.08304	-1.38815	1.25954	-0.85101	2.07735	9.22971	-0.00348	1.82335
10701016	4	0.68729	-7.13877	-1.84611	-4.26533	1.96227	0.72328	-0.04935	-3.64636	-0.71615	-0.22366
11101018	5	13.39392	-0.21551	-0.82974	-0.56936	-1.13924	-0.93810	1.67854	0.74027	1.09803	1.63564
11301012	6	11.29233	-3.46265	0.71031	-3.27511	1.81291	-1.14890	0.87795	0.68158	-0.93637	-0.00742
11301036	7	6.40983	-4.88472	0.49498	-0.60288	-1.23117	2.15722	-0.73488	0.16353	0.14870	0.92437
11401006	8	5.33763	-1.55396	-1.91070	-1.71917	-2.12124	2.17985	0.71370	-0.54681	-0.57421	-1.00673
11401042	9	0.48421	-0.05272	-1.35319	-1.67789	4.73235	-0.49048	0.57976	2.74694	0.83089	3.47905
11401045	10	11.53162	-0.53525	-1.01982	-3.63382	-1.13146	4.04794	-1.78224	1.46208	-2.38357	-2.05380
11401048	11	-2.40831	-3.29571	-2.80937	-4.21223	3.33053	2.79215	-0.25767	3.30176	0.79026	2.97060
11401041	12	1.35074	-5.21912	2.36190	-0.18517	0.50305	1.32472	-1.25769	-2.61975	-3.65554	-0.82281
11402036	13	1.39851	0.00983	-0.48464	0.84092	2.86172	1.25039	-0.85164	11.61090	1.84534	0.44978
11703016	14	-0.35216	6.05544	-9.25637	-5.61409	-1.02007	-5.07007	-2.13286	4.71396	1.37516	-3.15164
11703021	15	10.09667	-0.32808	0.71106	2.44586	0.54183	-0.86822	8.49649	-4.44257	2.60863	-3.63961
11802020	16	1.97396	-2.49000	2.88992	-7.54356	6.47000	2.14368	0.66263	1.88187	1.63223	0.23750
11802035	17	8.13675	0.30761	-2.55536	0.58236	0.59344	2.55255	2.24978	-1.47527	3.45057	-0.00410
11802042	18	16.06082	-0.78634	-2.00345	0.81092	1.37862	-2.63387	-1.54593	6.23507	-0.29354	0.28326
12001031	19	7.27827	-1.03821	0.08187	-2.96089	1.08483	-1.66742	-6.52253	1.83344	1.23296	4.42253
12001043	20	3.91298	-3.98174	-0.57001	-4.03127	-3.89523	1.47149	0.33386	2.90099	3.07792	0.54347
12201030	21	4.93885	3.43992	-5.23007	2.52891	1.65574	-0.43233	-3.47121	2.54974	0.31623	3.54599
12201037	22	7.57145	-2.02194	-0.93629	-4.49398	-8.09438	-4.21418	-2.82228	3.97723	-0.28040	-0.44980
12302003	23	16.17174	-2.74206	5.00713	4.03570	0.55019	-4.31649	4.15191	-3.83671	0.18153	0.91564
12302016	24	1.29305	2.70473	1.32788	-7.81795	1.98404	-4.14780	-3.75859	0.18733	-1.54507	2.35149
12302032	25	-1.72328	-1.56650	-1.17429	-10.95179	-0.74931	0.43211	0.99576	1.85774	1.49281	0.65943
12305007	26	6.92684	-3.71849	0.17466	2.12864	2.41604	-1.56262	0.39021	4.37498	-1.86123	-1.42325
12305010	27	11.53423	0.86082	-2.58580	0.31805	-0.17796	4.10355	-4.39172	6.35807	-1.90267	-2.31569
12305022	28	6.42098	-4.40026	-0.30682	-1.42233	-2.37889	1.94831	2.13775	1.88374	2.05466	-3.31725
12305043	29	2.75826	-1.32605	-1.07917	-5.48177	-0.04867	3.09618	-1.96263	0.64482	-1.12516	-4.91827
12404028	30	0.27725	1.83060	-4.82986	-0.31551	0.63511	1.39088	-0.59549	4.92121	2.17395	-1.23858
12404042	31	8.83495	-3.08571	0.38742	0.15540	0.44023	0.84716	-0.91779	-1.25898	1.36083	-1.71275
13502006	32	5.52501	-0.58855	1.56180	0.89847	-3.05921	6.81097	-1.70441	0.46087	-0.67443	0.69844
13502009	33	1.33505	1.95382	-12.53947	-2.19064	1.41920	0.10037	-5.57006	3.79309	6.95613	1.50613
13502019	34	14.41279	2.89853	1.87597	1.11650	3.71166	-1.56288	-2.09851	5.83292	1.16762	1.15110
13601011	35	3.11349	-6.70292	0.63133	-0.08444	-0.86219	-1.59212	-0.79742	0.26992	-0.75858	-0.96892
13606025	36	9.09692	-4.63288	2.05291	0.17276	-0.45654	1.85853	3.47082	2.34004	1.92965	-0.46972
13606034	37	-0.73204	-1.29877	0.06153	-1.41718	-0.48727	9.09654	0.87728	-0.08548	0.20150	1.13835
13606037	38	6.52726	0.59742	-2.91233	0.19978	-2.78397	1.84226	-5.21835	-0.37775	4.48512	-3.63684
13606049	39	11.42397	-0.55085	3.61773	-4.89948	-2.54552	-3.83303	-1.80100	5.98024	1.65329	-1.05152

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13606058	40	2.58395	-0.06697	-1.66623	0.20566	0.29420	-1.94509	1.04615	-0.43057	1.78328	-6.49093
13903025	41-	10.83009	-6.17935	-0.13782	-1.13217	-0.42619	0.38629	0.15608	-1.34165	-1.19299	3.87760
13903034	42-	14.78331	0.73275	4.22289	-1.78194	1.02858	3.25288	-2.36023	2.71355	-1.97183	0.87122
14409028	43-	0.93794	-5.21986	0.17082	1.72488	-1.30898	5.44414	2.12750	-0.32598	-1.70138	-1.83230
14409008	44-	3.69989	-8.19276	-1.67756	0.59376	-0.99605	0.98553	-0.59276	0.14686	0.18100	-0.21213
14409022	45-	2.84408	-5.53093	-0.23905	-0.47267	-2.08424	1.82373	-2.77159	-2.38116	0.29952	1.81660
15001015	46-	-2.01230	-0.72867	-1.03537	-4.96959	0.46444	→ -5.08120	-3.84290	1.78393	→ 5.11761	0.72679
15001030	47-	1.78554	-1.65247	-3.69212	-2.42192	4.36829	-0.94691	-1.93448	1.99844	-2.58936	-0.42845
20300026	48	3.60256	-0.37241	6.16712	-5.27344	-3.23421	-1.13715	5.30364	1.14567	1.51390	-1.29078
20300042	49-	11.71762	-8.15609	2.16143	1.47445	1.12282	-0.00796	-2.95351	-0.48883	-1.83213	0.62125
20705008	50-	18.15616	-3.42324	2.53251	0.51784	-0.43826	0.30185	5.11820	2.25648	1.76199	-2.61014
20714062	51	6.44772	-1.43146	2.28492	2.00038	-3.13511	-0.87292	-1.48640	-0.26278	0.69536	-1.49631
21102019	52-	2.67806	-3.67145	-1.21873	1.08089	-4.37081	2.02994	2.21367	-1.17249	1.07095	-0.47696
21102030	53-	4.84182	-2.20403	-0.24757	-3.63295	-0.03175	2.10159	0.10482	3.75762	0.29961	1.05237
21603011	54-	7.41543	2.17367	-5.92651	3.39263	1.59714	-3.01809	-1.90252	2.43781	3.46794	1.18773
21604002	55-	8.60453	-2.33714	-1.87162	-0.55492	-0.86650	4.38691	-0.76372	-1.02848	-0.26045	0.50425
21604006	56-	5.06999	-4.24150	1.52621	-0.81357	-0.04204	0.56436	1.94453	1.89577	1.29455	-0.81561
22104005	57-	-1.50078	-1.53948	-1.70008	-0.71750	1.33724	-0.87274	-6.03105	-0.23652	0.67260	-0.59049
22800008	58-	7.37664	-4.12914	1.84734	-4.77144	-2.21252	-0.04270	0.68485	1.39829	2.22316	-0.77016
22800012	59-	0.01400	0.09833	-0.38056	-3.41338	-0.42822	-2.34347	0.37686	7.39856	-0.03290	-0.47425
23003008	60-	5.06390	-2.49575	-4.11720	1.59397	3.11487	4.26179	-1.51872	3.88501	3.81720	-0.28181
23003028	61-	2.09531	0.12014	-3.08920	-0.81289	0.14475	1.20402	-1.27874	6.26196	1.17902	0.95211
23006009	62-	-1.63353	0.43243	-0.62153	-6.72070	-0.85208	1.07048	0.22992	-0.26387	-0.48267	-1.87031
23006025	63-	-1.83990	-0.87612	-11.15363	-1.16382	-0.49711	-1.11793	0.88942	4.75968	0.58885	-2.06347
23606049	64-	4.20617	-4.47743	0.44230	-1.14623	0.86711	1.67281	0.88743	1.88885	1.62878	0.72308
23402005	65-	10.55923	-0.85559	4.93968	3.34013	1.21089	-1.02563	0.44051	3.59403	-2.00701	-2.08502
23402032	66-	6.44376	5.47133	-1.87253	0.13473	5.38650	-1.90819	-0.56564	4.38870	9.76888	-0.53213
23800004	67-	9.11985	-2.44143	-4.70417	-4.27860	-5.22211	1.45006	-1.83666	1.40589	0.27775	-2.03132
23800010	68-	3.55654	-4.00875	-0.99300	-3.18780	-3.83327	-0.73423	-0.33988	-2.13234	3.13774	-2.57138
23800018	69-	14.24193	0.74779	-0.11688	4.27654	2.27707	-3.60399	2.02949	-1.25225	-0.20486	-2.58673
23800084	70	-3.00079	-1.79021	-1.06192	-1.00016	-2.98002	2.56000	-0.55012	-1.02219	0.02012	-1.91844 ← ?
23800096	71-	11.34831	0.79564	-3.12663	-0.95308	9.23555	-2.39979	-2.81263	4.12136	4.87720	-2.71052
24601026	72-	5.93816	-0.41043	1.03731	-0.88276	-1.01280	2.05566	1.05998	1.42494	-0.25359	-0.23502
24804024	73-	-2.24884	-0.47693	-1.67649	-2.17484	0.39813	-0.09492	-0.06118	1.92778	5.44844	-1.90979
24804052	74-	3.28020	7.91060	-1.23681	-5.69984	2.60871	-4.55202	-6.09008	10.31890	5.53564	-4.67851
25400006	75-	11.16243	-1.49916	-6.29180	2.06835	-0.96831	-3.49359	0.24388	2.09297	0.29107	2.58581
25400022	76-	9.44046	-1.32583	0.18837	0.01378	0.37240	0.61055	1.90182	-3.46412	-4.25126	-0.35105
26101033	77-	2.16377	0.25616	-1.99714	-8.41298	1.27621	-2.39467	-2.64130	2.57411	2.36847	3.27651
26101038	78-	9.78134	-5.36415	0.21543	-2.97127	0.96176	0.76727	-2.34029	-0.29248	0.50082	1.71961
26700025	79-	-4.37745	-2.63162	-6.32142	0.91361	3.30977	1.98393	-2.35189	0.44680	1.93155	-4.73191
27200014	80-	1.40623	2.05435	-3.42973	1.24837	13.98422	-3.86614	-4.37664	1.56094	2.73479	-3.13477
		38	7	6	9	6	3	1	6	3	1
		37	7	6	9	6	3	2	6	3	1

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APPENDIX C

Computer Printouts for Owen's

Graph Method

5. OWEN'S GRAPH TECHNIQUE

HISTOGRAM OF COEFFICIENTS MATCHED & NO MATCHED DIFFERENCES ≤ ONE + TWO STANDARD ERROR OF MEASUREMENT.

FREQUENCY CLASS	NUMBER	PERCENT	CUMULATIVE PERCENT	CUMULATIVE REMAINDER
.00	29	.93	.92	99.08
.01	14	.44	1.36	98.64
.02	12	.39	1.74	98.26
.03	25	.79	2.53	97.47
.04	69	2.18	4.72	95.28
.05	47	1.50	6.20	93.80
.06	58	1.85	8.04	91.96
.07	103	3.27	11.30	88.70
.08	80	2.53	13.83	86.17
.09	99	3.13	16.96	83.04
.10	99	3.13	20.09	79.91
.11	134	4.24	24.34	75.66
.12	121	3.84	28.16	71.84
.13	129	4.08	32.25	67.75
.14	137	4.35	36.58	63.42
.15	173	5.47	42.06	57.94
.16	152	4.81	46.87	53.13
.17	160	5.06	51.93	48.07
.18	130	4.11	56.04	43.96
.19	151	4.79	60.82	39.18
.20	137	4.35	65.16	34.84
.21	112	3.54	68.70	31.30
.22	126	4.00	72.69	27.31
.23	102	3.24	75.92	24.08
.24	106	3.35	79.27	20.73
.25	90	2.86	82.12	17.88
.26	79	2.51	84.62	15.38
.27	79	2.51	87.12	12.88
.28	67	2.12	89.24	10.76
.29	42	1.34	90.57	9.43
.30	62	1.96	92.53	7.47
.31	36	1.15	93.67	6.33
.32	40	1.28	94.94	5.06
.33	25	.79	95.73	4.27
.34	29	.93	96.65	3.35
.35	19	.60	97.25	2.75
.36	14	.44	97.69	2.31
.37	18	.58	98.26	1.74
.38	12	.39	98.64	1.36
.39	11	.36	98.99	1.01
.40	6	.20	99.18	.82
.41	6	.20	99.37	.63
.42	5	.17	99.53	.47
.43	4	.14	99.65	.35
.44	1	.03	99.68	.32
.45	8	.25	99.94	.06
.46	1	.03	99.97	.03
.47	0	.00	99.97	.03
.48	0	.00	99.97	.03

6.

OWEN'S GRAPH TECHNIQUE

HISTOGRAM OF COEFFICIENTS MATCHED + NO MATCHED DIFFERENCE ≤ TWO + FOUR STANDARD ERROR OF MEASUREMENT

$S = M/(M+U)$

FREQUENCY CLASS	NUMBER	PERCENT	CUMULATIVE PERCENT	CUMULATIVE REMAINDER
.00	3	.09	.09	99.91
.01	0	.00	.09	99.91
.02	4	.14	.22	99.78
.03	6	.20	.41	99.59
.04	10	.33	.73	99.27
.05	6	.20	.92	99.08
.06	7	.22	1.14	98.86
.07	17	.55	1.68	98.32
.08	13	.41	2.09	97.91
.09	13	.41	2.50	97.50
.10	34	1.09	3.58	96.42
.11	30	.96	4.53	95.47
.12	35	1.12	5.63	94.37
.13	30	.96	6.58	93.42
.14	45	1.42	8.01	91.99
.15	46	1.47	9.46	90.54
.16	43	1.36	10.82	89.18
.17	67	2.12	12.94	87.06
.18	69	2.18	15.13	84.87
.19	83	2.64	17.75	82.25
.20	77	2.45	20.19	79.81
.21	113	3.59	23.77	76.23
.22	112	3.54	27.31	72.69
.23	98	3.10	30.41	69.59
.24	122	3.86	34.27	65.73
.25	117	3.70	37.97	62.03
.26	142	4.49	42.47	57.53
.27	124	3.92	46.39	53.61
.28	138	4.38	50.76	49.24
.29	124	3.92	54.68	45.32
.30	121	3.84	58.51	41.49
.31	123	3.89	62.41	37.59
.32	120	3.81	66.20	33.80
.33	109	3.46	69.65	30.35
.34	111	3.51	73.16	26.84
.35	95	3.02	76.17	23.83
.36	91	2.89	79.05	20.95
.37	95	3.02	82.06	17.94
.38	71	2.26	84.30	15.70
.39	71	2.26	86.55	13.45
.40	71	2.26	88.80	11.20
.41	71	2.26	91.04	8.96
.42	41	1.31	92.34	7.66
.43	35	1.12	93.45	6.55
.44	34	1.09	94.53	5.47
.45	31	.98	95.51	4.49
.46	30	.96	96.46	3.54
.47	21	.66	97.12	2.88
.48	13	.41	97.53	2.47

7.

.49	***********	17	.55	98.07	1.93
.50	***********	17	.55	98.61	1.39
.51	******	9	.28	98.89	1.11
.52	*****	8	.25	99.15	.85
.53	***	5	.17	99.30	.70
.54	*****	8	.25	99.56	.44
.55	****	6	.20	99.75	.25
.56	*	2	.06	99.81	.19
.57		0	.00	99.81	.19
.58		0	.00	99.81	.19
.59	*	2	.06	99.87	.13
.60	*	2	.06	99.94	.06
.61	*	1	.03	99.97	.03
.62		0	.00	99.97	.03
.63		0	.00	99.97	.03
.64	*	1	.03	100.00	.00
.65		0	.00	100.00	.00
.66		0	.00	100.00	.00
.67		0	.00	100.00	.00
.68		0	.00	100.00	.00
.69		0	.00	100.00	.00
.70		0	.00	100.00	.00
.71		0	.00	100.00	.00
.72		0	.00	100.00	.00
.73		0	.00	100.00	.00
.74		0	.00	100.00	.00
.75		0	.00	100.00	.00
.76		0	.00	100.00	.00
.77		0	.00	100.00	.00
.78		0	.00	100.00	.00
.79		0	.00	100.00	.00
.80		0	.00	100.00	.00
.81		0	.00	100.00	.00
.82		0	.00	100.00	.00
.83		0	.00	100.00	.00
.84		0	.00	100.00	.00
.85		0	.00	100.00	.00
.86		0	.00	100.00	.00
.87		0	.00	100.00	.00
.88		0	.00	100.00	.00
.89		0	.00	100.00	.00
.90		0	.00	100.00	.00
.91		0	.00	100.00	.00
.92		0	.00	100.00	.00
.93		0	.00	100.00	.00
.94		0	.00	100.00	.00
.95		0	.00	100.00	.00
.96		0	.00	100.00	.00
.97		0	.00	100.00	.00
.98		0	.00	100.00	.00
.99		0	.00	100.00	.00
1.00		0	.00	100.00	.00

HISTOGRAM UNIT VALUE = 1.578 MEAN COEFFICIENT = .285

8. OWEN'S GRAPH TECHNIQUE

HISTOGRAM OF COEFFICIENTS MATCHED & NO MATCHED DIFFERENCE = TWO STNDARD ERROR OF MEASURMENT AND TWO STANDARD DIVIATIONS.

FREQUENCY CLASS		NUMBER	PERCENT	CUMULATIVE PERCENT	CUMULATIVE REMAINDER
.00		0	.00	.00	100.00
.01		0	.00	.00	100.00
.02		0	.00	.00	100.00
.03		0	.00	.00	100.00
.04		0	.00	.00	100.00
.05		0	.00	.00	100.00
.06		0	.00	.00	100.00
.07		0	.00	.00	100.00
.08		0	.00	.00	100.00
.09		0	.00	.00	100.00
.10		0	.00	.00	100.00
.11	*	1	.03	.03	99.97
.12		0	.00	.03	99.97
.13		0	.00	.03	99.97
.14		0	.00	.03	99.97
.15	*	2	.06	.09	99.91
.16		0	.00	.09	99.91
.17		0	.00	.09	99.91
.18	*	3	.09	.19	99.81
.19	*	3	.09	.28	99.72
.20	**	4	.14	.41	99.59
.21	**	4	.14	.54	99.46
.22	*	2	.06	.60	99.40
.23	*****	10	.33	.92	99.08
.24	****	9	.28	1.20	98.80
.25	****	9	.28	1.49	98.51
.26	***********	22	.71	2.18	97.82
.27	**********	21	.66	2.85	97.15
.28	***********	23	.74	3.58	96.42
.29	*************	27	.85	4.43	95.57
.30	********************	40	1.28	5.70	94.30
.31	********************	40	1.28	6.96	93.04
.32	**********************	45	1.42	8.39	91.61
.33	***************************************	78	2.48	10.85	89.15
.34	***	86	2.72	13.58	86.42
.35	***	95	3.02	16.58	83.42
.36	***	98	3.10	19.68	80.32
.37	***	114	3.62	23.29	76.71
.38	***	143	4.54	27.82	72.18
.39	**	153	4.84	32.66	67.34
.40	***	154	4.87	37.53	62.47
.41	***	174	5.52	43.04	56.96
.42	**	160	5.06	48.10	51.90
.43	***	183	5.79	53.89	46.11
.44	**	173	5.47	59.37	40.63
.45	**	181	5.74	65.09	34.91
.46	***	139	4.41	69.49	30.51
.47	***	155	4.92	74.40	25.60
.48	**	133	4.22	78.61	21.39

9.

.49	**	135	4.27	82.88	17.12
.50	***	107	3.40	86.27	13.73
.51	***	88	2.78	89.05	10.95
.52	************************************	73	2.31	91.36	8.64
.53	*****************************	58	1.85	93.20	6.80
.54	****************************	56	1.77	94.97	5.03
.55	******************	37	1.17	96.14	3.86
.56	****************	33	1.04	97.18	2.82
.57	*****************	34	1.09	98.26	1.74
.58	********	17	.55	98.80	1.20
.59	******	12	.39	99.18	.82
.60	****	8	.25	99.43	.57
.61	*****	10	.33	99.75	.25
.62	**	5	.17	99.91	.09
.63	*	1	.03	99.94	.06
.64	*	1	.03	99.97	.03
.65		0	.00	99.97	.03
.66	*	1	.03	100.00	.00
.67		0	.00	100.00	.00
.68		0	.00	100.00	.00
.69		0	.00	100.00	.00
.70		0	.00	100.00	.00
.71		0	.00	100.00	.00
.72		0	.00	100.00	.00
.73		0	.00	100.00	.00
.74		0	.00	100.00	.00
.75		0	.00	100.00	.00
.76		0	.00	100.00	.00
.77		0	.00	100.00	.00
.78		0	.00	100.00	.00
.79		0	.00	100.00	.00
.80		0	.00	100.00	.00
.81		0	.00	100.00	.00
.82		0	.00	100.00	.00
.83		0	.00	100.00	.00
.84		0	.00	100.00	.00
.85		0	.00	100.00	.00
.86		0	.00	100.00	.00
.87		0	.00	100.00	.00
.88		0	.00	100.00	.00
.89		0	.00	100.00	.00
.90		0	.00	100.00	.00
.91		0	.00	100.00	.00
.92		0	.00	100.00	.00
.93		0	.00	100.00	.00
.94		0	.00	100.00	.00
.95		0	.00	100.00	.00
.96		0	.00	100.00	.00
.97		0	.00	100.00	.00
.98		0	.00	100.00	.00
.99		0	.00	100.00	.00
1.00		0	.00	100.00	.00

HISTOGRAM UNIT VALUE = 2.033 MEAN COEFFICIENT = .426

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DISCRIMINANT FUNCTION + POSTERIOR PROBABILITIES — OWEN'S .48 - NON-DISJUNCTIVE CONDENSATION

VARIABLE	FUNCTION A	B	C	D	E	F	G	H
1	6.07768	5.73349	5.73303	6.33846	6.66403	6.10765	6.02735	6.22062
2	-.10739	-.11289	-.02259	-.03125	-.21380	-.07352	-.09862	-.03760
3	2.81986	3.05416	2.56729	2.35434	3.05004	2.62706	2.84244	2.36927
4	-.43312	-.37288	-.36843	-.24811	-.44090	-.19916	-.08126	-.50473
5	-1.04822	-1.19139	-.73784	-.98342	-.95273	-.90660	-.99696	-.81988
6	-2.03513	-1.85549	-1.46090	-1.95943	-2.36645	-2.20020	-2.14449	-2.19340
7	.83921	.77867	.26550	1.04623	.77746	.49992	.44152	1.21189
8	-.10237	-.24008	-.49812	-.42048	-.44779	-.69048	-.64774	-.45775
9	5.33272	5.23718	5.13607	5.15610	4.52789	5.20351	5.26888	5.00506
10	-9.40948	-10.25757	-10.08813	-10.12809	-9.10979	-9.69784	-10.14414	-8.97459
11	-1.62437	-1.05560	-1.51176	-1.41427	-.70032	-1.10250	-1.28289	-.60752
12	3.58337	3.35788	3.31360	3.44906	3.08570	3.22337	3.29916	3.12482
13	-1.29075	-2.12312	-2.52495	-1.68067	-.93545	-1.75504	-1.99036	-1.98051
14	-.87827	-1.12026	-.90343	-1.16815	-.66834	-1.15171	-1.25256	-1.11977
15	-1.34984	-1.54253	-.63533	-1.78080	-.30898	-.83434	-1.32952	-.45363
16	-3.89012	-4.99319	-4.51877	-4.50225	-7.95164	-5.26930	-5.33518	-4.32465
17	-4.10493	-4.11458	-3.20024	-3.75653	-5.27506	-3.86720	-3.22272	-4.93211
18	13.63960	13.93739	14.73743	15.58843	15.39611	15.11537	15.14093	13.92266
19	-24.26284	-24.29321	-26.92525	-25.90477	-25.05859	-25.03873	-24.22280	-25.24779
20	19.49819	19.92652	22.71075	23.22929	23.84645	21.80423	21.30319	23.49595
21	-2.14126	-.84025	-1.26164	-3.68333	-4.20351	-2.49574	-2.58780	-2.99654
22	2.80944	3.00779	2.98779	2.77770	2.78703	3.04423	3.07773	2.99389
23	1.35746	1.20709	1.25572	1.56367	1.18905	1.37049	1.23707	1.25628
24	-.31711	-.17739	-.35012	-.42429	.39026	-.33832	-.30632	.08133
25	1.05098	1.36905	1.51172	1.08004	1.11497	1.18956	1.20506	1.04601
26	3.02770	2.69892	2.78858	3.12847	3.28561	2.84817	2.84574	2.74113
27	1.97217	1.97773	1.87444	2.22022	1.50243	2.04744	2.04718	2.02840
CONSTANT	-317.45023	-317.26004	-321.01224	-343.31299	-330.38185	-323.27240	-318.81992	-338.47192

GROUP WITH LARGEST PROB. — SQUARE OF DISTANCE FROM AND POSTERIOR PROBABILITY FOR GROUP -

GROUP A

CASE	GROUP	A		B		C		D		E		F		G		H	
ok 1 11	B	26.497	.327,	25.639	.502,	32.800	.014,	32.024	.021,	44.630	.000,	29.848	.061,	29.461	.074,	39.837	.000,
ok 2 16	A	38.106	.838,	53.829	.000,	53.178	.000,	41.650	.142,	47.586	.007,	49.707	.003,	47.202	.009,	54.914	.000,
ok 3 17	C	26.576	.058,	24.931	.103,	21.514	.568,	27.408	.030,	35.141	.001,	24.393	.135,	26.263	.053,	26.263	.053,
ok 4 26	D	16.290	.107,	21.131	.010,	20.209	.015,	12.786	.616,	21.731	.007,	15.954	.126,	17.321	.064,	17.628	.055,
5 32	H	26.582	.046,	29.612	.010,	23.802	.186,	28.960	.014,	35.969	.000,	30.209	.008,	31.748	.003,	21.760	.732,
6 50	A	28.836	.983,	41.179	.002,	48.436	.000,	42.403	.001,	54.814	.000,	40.386	.003,	37.916	.010,	54.546	.000,
7 58	A	19.666	.641,	28.315	.008,	33.751	.001,	21.196	.298,	38.888	.000,	25.543	.034,	27.585	.012,	28.959	.006,
8 62	A	18.603	.482,	25.583	.015,	29.357	.002,	23.663	.038,	29.984	.002,	20.509	.186,	19.775	.268,	27.364	.006,
ok 9 68	G	12.199	.070,	12.094	.074,	11.929	.080,	11.746	.087,	24.093	.000,	9.426	.279,	8.701	.401,	16.247	.009,
10 78	A	28.505	.785,	32.694	.097,	36.382	.015,	35.993	.019,	38.590	.005,	35.491	.024,	36.067	.018,	[illegible]	[illegible]

		A		B		C		D		E		F		G		H	
11	H	23.423	.785,	32.547	.008,	32.299	.009,	29.450	.037,	37.671	.001,	27.011	.124,	29.662	.033,	33.763	.004,

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GROUP B

CASE		A		B		C		D		E		F		G		H	
1 11	B	26.497	.327,	25.639	.502,	32.800	.014,	32.024	.021,	44.630	.000,	29.848	.061,	29.461	.074,	39.837	.000,
ok 2 22	E	37.269	.000,	32.850	.000,	32.751	.000,	34.464	.000,	16.930	.995,	28.560	.003,	31.665	.001,	35.113	.000,
3 33	B	52.692	.003,	40.845	.993,	52.414	.003,	57.533	.000,	65.343	.000,	57.324	.000,	56.323	.000,	60.772	.000,
— 4 43	C	40.572	.003,	34.794	.055,	29.218	.896,	42.620	.001,	50.800	.000,	40.103	.004,	39.392	.006,	35.711	.035,
ok 5 57	G	33.338	.005,	25.804	.206,	27.844	.074,	31.792	.010,	25.942	.192,	27.055	.110,	24.470	.401,	35.276	.002,
6 59	B	40.358	.006,	31.067	.665,	41.213	.004,	36.562	.043,	49.499	.000,	33.991	.154,	35.125	.087,	36.677	.040,
7 64	B	24.672	.007,	16.235	.369,	17.812	.168,	21.009	.034,	24.537	.006,	20.175	.052,	21.780	.023,	16.396	.341,
8 66	B	38.498	.032,	31.864	.894,	40.615	.011,	45.881	.001,	63.662	.000,	39.712	.018,	37.876	.044,	54.804	.000,
ok 9 68	G	12.199	.070,	12.094	.074,	11.929	.080,	11.746	.087,	24.093	.000,	9.426	.279,	8.701	.401,	16.247	.009,
10 73	B	12.858	.125,	10.007	.522,	16.788	.018,	13.170	.107,	20.618	.003,	14.782	.048,	14.181	.065,	13.675	.113,

GROUP C

CASE		A		B		C		D		E		F		G		H	
ok 1 1	F	24.476	.025,	23.631	.038,	20.983	.142,	20.846	.152,	31.699	.001,	18.979	.386,	19.914	.242,	25.520	.015,
2 3	C	65.571	.000,	60.067	.003,	48.100	.993,	63.444	.000,	75.977	.000,	60.347	.002,	60.508	.002,	82.214	.000,
3 17	C	26.676	.058,	24.931	.103,	21.514	.568,	27.408	.030,	35.141	.001,	24.393	.135,	26.263	.053,	26.263	.053,
ok 4 19	E	32.535	.010,	29.676	.041,	26.875	.166,	35.503	.002,	24.162	.645,	28.628	.069,	28.762	.065,	36.631	.002,
5 21	C	58.961	.000,	51.000	.005,	40.321	.992,	59.664	.000,	65.617	.000,	53.032	.002,	53.823	.001,	66.629	.000,
ok 6 30	D	29.741	.013,	24.031	.224,	23.905	.238,	23.327	.318,	33.352	.002,	26.004	.083,	25.568	.104,	29.135	.017,
— 7 32	H	26.582	.046,	29.612	.010,	23.802	.186,	28.960	.014,	35.969	.000,	30.209	.008,	31.748	.003,	21.660	.732,
8 38	C	63.271	.000,	53.507	.012,	44.656	.985,	59.631	.001,	72.496	.000,	62.119	.000,	59.202	.001,	57.620	.002,
— 9 53	H	22.111	.072,	20.305	.177,	20.509	.160,	21.240	.111,	25.091	.016,	20.812	.138,	24.089	.027,	19.267	.298,
10 55	C	18.858	.160,	23.232	.018,	15.939	.687,	26.829	.003,	37.846	.000,	22.749	.023,	19.662	.107,	26.928	.003,
ok 11 64	B	24.672	.007,	16.235	.369,	17.812	.168,	21.009	.034,	24.537	.006,	20.175	.052,	21.780	.023,	16.396	.341,
ok 12 67	F	28.952	.006,	26.595	.020,	23.728	.086,	27.083	.016,	29.794	.004,	19.926	.574,	21.345	.282,	27.875	.011,
ok 13 68	G	12.199	.070,	12.094	.074,	11.929	.080,	11.746	.087,	24.093	.000,	9.426	.279,	8.701	.401,	16.247	.009,

GROUP D

CASE		A		B		C		D		E		F		G		H	
ok 1 1	F	24.476	.025,	23.631	.038,	20.983	.142,	20.846	.152,	31.699	.001,	18.979	.386,	19.914	.242,	25.520	.015,
2 4	D	23.362	.259,	28.102	.024,	33.913	.001,	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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		25.614	.084,												
12 3 6	D	31.258	.379,	46.624	.000,	44.390	.001,	30.745	.490,	48.679	.000,	35.456	.047,	34.293	.083,
		51.318	.000,												
4 8	D	24.591	.211,	32.016	.005,	29.243	.021,	23.253	.412,	31.801	.006,	25.902	.110,	28.659	.028,
		24.618	.208,												
5 9	D	19.177	.021,	19.428	.018,	20.488	.011,	13.120	.426,	23.760	.002,	14.033	.270,	14.322	.234,
		19.334	.019,												
6 26	D	16.290	.107,	21.131	.010,	20.209	.015,	12.786	.616,	21.731	.007,	15.954	.126,	17.321	.064,
		17.628	.055,												
7 30	D	29.741	.013,	24.031	.224,	23.905	.238,	23.327	.318,	33.352	.002,	26.004	.083,	25.568	.104,
		29.135	.017,												
ok 8 34	F	26.366	.074,	26.367	.074,	31.078	.007,	25.622	.108,	36.323	.001,	22.771	.449,	23.747	.276,
		30.227	.011,												
— 9 36	A	32.594	.675,	39.664	.020,	42.504	.005,	34.339	.282,	49.149	.000,	42.321	.005,	42.505	.005,
		41.294	.009,												
10 44	D	48.[illegible]86	.021,	55.992	.000,	50.871	.005,	40.648	.868,	56.625	.000,	45.071	.095,	49.722	.009,
		54.716	.001,												
— 11 51	G	30.746	.035,	28.711	.096,	28.401	.112,	28.320	.117,	34.007	.007,	27.084	.217,	25.854	.401,
		32.474	.015,												
12 57	D	40.907	.003,	39.931	.005,	40.084	.004,	29.574	.808,	48.660	.000,	36.439	.026,	35.112	.051,
		33.671	.104,												
ok 13 58	A	19.666	.641,	28.315	.008,	33.751	.001,	21.196	.298,	38.888	.000,	25.543	.034,	27.585	.012,
		28.959	.006,												
ok 14 64	B	24.[illegible]72	.007,	16.235	.369,	17.812	.168,	21.009	.034,	24.537	.006,	20.175	.052,	21.780	.023,
		16.396	.341,												
ok 15 65	F	22.327	.016,	23.686	.008,	19.847	.056,	17.335	.197,	25.339	.004,	15.745	.437,	16.667	.276,
		24.612	.005,												
16 72	D	33.646	.003,	34.929	.002,	30.468	.017,	22.796	.772,	44.022	.000,	27.705	.066,	31.479	.010,
		26.362	.130,												
ok 17 73	B	12.858	.125,	10.007	.522,	16.788	.018,	13.170	.107,	20.618	.003,	14.782	.048,	14.181	.065,
		13.[illegible]75	.113,												
— 18 76	E	31.291	.049,	40.488	.000,	37.120	.003,	28.773	.172,	25.960	.701,	32.529	.026,	32.328	.029,
		33.114	.020,												
19 77	D	38.512	.044,	41.665	.009,	39.600	.026,	32.616	.842,	42.985	.005,	38.637	.042,	39.521	.027,
		42.535	.006,												
20 79	D	43.277	.007,	46.050	.002,	47.601	.001,	33.283	.974,	48.087	.001,	45.686	.002,	48.395	.001,
		41.812	.014,												

GROUP E		A / H		B		C		D		E		F		G	
CASE															
1 19	E	32.535	.010,	29.676	.041,	26.875	.166,	35.503	.002,	24.162	.645,	28.628	.069,	28.762	.065,
		36.[illegible]31	.002,												
2 22	E	37.269	.000,	32.850	.000,	32.751	.000,	34.464	.000,	10.930	.995,	28.560	.003,	31.665	.001,
		35.113	.000,												
3 24	E	62.825	.000,	62.735	.000,	59.855	.000,	57.933	.000,	36.953	1.000,	54.890	.000,	56.381	.000,
		58.785	.000,												
ok 4 28	H	18.314	.038,	18.044	.043,	22.667	.004,	18.087	.042,	20.607	.012,	15.751	.136,	18.086	.042,
		12.518	.683,												
5 46	E	28.626	.006,	24.330	.049,	26.391	.017,	24.033	.056,	18.869	.745,	23.484	.074,	24.186	.052,
		32.347	.001,												
6 47	E	31.245	.001,	33.019	.000,	37.958	.000,	29.086	.003,	17.305	.985,	29.489	.002,	29.173	.003,
		27.353	.006,												
7 63	E	54.473	.000,	50.296	.000,	56.056	.000,	49.371	.000,	30.764	1.000,	50.977	.000,	52.577	.000,
		53.150	.000,												
8 67	E	31.291	.049,	40.488	.000,	37.120	.003,	28.773	.172,	25.960	.701,	32.529	.026,	32.328	.029,
		33.114	.020,												

GROUP F		A / H		B		C		D		E		F		G	
CASE															
1 1	F	24.476	.025,	23.631	.038,	20.983	.142,	20.846	.152,	31.699	.001,	18.979	.386,	19.914	.242,
		25.520	.015,												
2 5	F	23.[illegible]37	.025,	23.607	.019,	24.677	.011,	18.004	.306,	20.177	.103,	17.960	.313,	18.750	.211,
		[illegible]	[illegible]												

Case	Group	A / H		B		C		D		E		F		G	
15 OK 3 8	D	24.591	.211,	32.016	.005,	29.243	.021,	23.253	.412,	31.801	.006,	25.902	.110,	28.659	.028,
		24.618	.208,												
OK 4 4	D	19.177	.021,	19.428	.018,	20.488	.011,	13.120	.426,	23.760	.002,	14.033	.270,	14.322	.234,
		19.334	.019,												
OK 5 10	G	26.163	.052,	26.921	.036,	23.138	.238,	26.817	.038,	33.477	.001,	22.774	.285,	22.451	.335,
		28.865	.014,												
6 20	B	20.603	.124,	17.388	.616,	20.187	.152,	26.393	.007,	30.460	.001,	22.107	.058,	22.767	.042,
		32.100	.000,												
7 25	F	37.418	.027,	35.332	.077,	39.322	.010,	41.334	.004,	40.936	.005,	31.558	.509,	32.393	.335,
		37.689	.032,												
OK 8 26	D	16.290	.107,	21.131	.010,	20.209	.015,	12.786	.616,	21.731	.007,	15.954	.126,	17.321	.064,
		17.628	.055,												
9 27	F	38.549	.004,	36.393	.011,	35.878	.014,	35.854	.014,	42.849	.000,	28.721	.498,	29.695	.306,
		31.669	.154,												
10 34	F	26.366	.074,	26.367	.074,	31.078	.007,	25.622	.108,	36.323	.001,	22.771	.449,	23.747	.276,
		30.227	.011,												
OK 11 35	G	28.205	.030,	24.342	.204,	34.763	.001,	29.642	.014,	30.605	.009,	23.304	.343,	23.128	.374,
		28.495	.026,												
OK 12 46	E	28.626	.006,	24.330	.049,	26.391	.017,	24.033	.056,	18.869	.745,	23.484	.074,	24.186	.052,
		32.347	.001,												
13 48	F	33.527	.089,	36.373	.021,	35.777	.029,	39.128	.005,	42.962	.001,	29.814	.567,	31.221	.281,
		38.473	.007,												
14 61	F	20.490	.035,	19.769	.051,	17.405	.165,	16.432	.269,	25.380	.003,	16.027	.329,	17.954	.126,
		21.418	.022,												
15 65	F	22.327	.016,	23.686	.008,	19.847	.056,	17.335	.197,	25.339	.004,	15.745	.437,	16.667	.276,
		24.612	.005,												
16 67	F	28.952	.006,	26.595	.020,	23.728	.086,	27.083	.016,	29.794	.004,	19.926	.574,	21.345	.282,
		27.875	.011,												
OK 17 68	G	12.199	.070,	12.094	.074,	11.929	.080,	11.746	.087,	24.093	.000,	9.426	.279,	8.701	.401,
		16.247	.009,												
OK 18 75	G	31.624	.007,	23.326	.317,	25.266	.120,	29.223	.017,	34.569	.001,	24.205	.204,	23.232	.332,
		34.177	.001,												
19 80	A	23.323	.785,	32.547	.008,	32.299	.009,	29.450	.037,	37.671	.001,	27.011	.124,	29.662	.033,
		33.763	.004,												

GROUP

G

CASE		A / H		B		C		D		E		F		G	
OK 1 1	F	24.476	.025,	23.631	.038,	20.983	.142,	20.846	.152,	31.699	.001,	18.979	.386,	19.914	.242,
		25.520	.015,												
OK 2 5	F	23.637	.025,	23.607	.019,	24.677	.011,	18.004	.306,	20.177	.103,	17.960	.313,	18.750	.211,
		24.252	.013,												
3 8	G	121.606	.002,	120.932	.002,	121.294	.002,	120.698	.003,	127.192	.000,	117.532	.013,	108.966	.977,
		125.600	.000,												
OK 4 4	D	19.177	.021,	19.428	.018,	20.488	.011,	13.120	.426,	23.760	.002,	14.033	.270,	14.322	.234,
		19.334	.019,												
OK 5 10	G	26.163	.052,	26.921	.036,	23.138	.238,	26.817	.038,	33.477	.001,	22.774	.285,	22.451	.335,
		28.865	.014,												
6 20	B	20.603	.124,	17.388	.616,	20.187	.152,	26.393	.007,	30.460	.001,	22.107	.058,	22.767	.042,
		32.100	.000,												
OK 7 25	F	37.418	.027,	35.332	.077,	39.322	.010,	41.334	.004,	40.936	.005,	31.558	.509,	32.393	.335,
		37.689	.032,												
OK 8 26	D	16.290	.107,	21.131	.010,	20.209	.015,	12.786	.616,	21.731	.007,	15.954	.126,	17.321	.064,
		17.628	.055,												
OK 9 27	F	38.549	.004,	36.393	.011,	35.878	.014,	35.854	.014,	42.849	.000,	28.721	.498,	29.695	.306,
		31.669	.154,												
OK 10 34	F	26.366	.074,	26.367	.074,	31.078	.007,	25.622	.108,	36.323	.001,	22.771	.449,	23.747	.276,
		30.227	.011,												
11 35	G	28.205	.030,	24.342	.204,	34.763	.001,	29.642	.014,	30.605	.009,	23.304	.343,	23.128	.374,
		28.495	.026,												
OK 12 46	E	28.626	.006,	24.330	.049,	26.391	.017,	24.033	.056,	18.869	.745,	23.484	.074,	24.186	.052,
		32.347	.001,												
OK 13 48	F	33.527	.089,	36.373	.021,	35.777	.029,	39.128	.005,	42.962	.001,	29.814	.567,	31.221	.281,
		38.473	.007,												
14	F	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Case	Handwritten	Actual	A	p	B	p	C	p	D	p	E	p	F	p	G	p	H	p
[illegible]		F	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.380	.003,	18.027	.329,	17.954	.126,	21.418	.022,
14 15	65	F	22.327	.016,	23.686	.008,	19.847	.056,	17.335	.197,	25.339	.004,	15.745	.437,	16.667	.276,	24.612	.005,
OK 16	67	F	28.952	.006,	26.595	.020,	23.728	.086,	27.083	.016,	29.794	.004,	19.926	.574,	21.345	.282,	27.875	.011,
17	68	G	12.199	.070,	12.094	.074,	11.929	.080,	11.746	.087,	24.093	.000,	9.426	.279,	8.701	.401,	16.247	.009,
18	25	G	31.624	.007,	23.326	.317,	25.266	.120,	29.223	.017,	34.569	.001,	24.205	.204,	23.232	.332,	34.177	.001,
OK 19	50	A	23.323	.785,	32.547	.008,	32.299	.009,	29.450	.037,	37.671	.001,	27.011	.124,	29.662	.033,	33.763	.004,
20	7	G	34.521	.061,	34.026	.079,	33.164	.121,	32.071	.209,	49.373	.000,	33.489	.103,	30.699	.415,	37.634	.013,
21	41	G	22.912	.089,	26.543	.014,	20.872	.246,	21.695	.163,	40.193	.000,	21.626	.168,	20.343	.320,	32.823	.001,
22	49	G	53.361	.044,	62.097	.001,	62.610	.000,	57.618	.005,	60.234	.001,	52.718	.061,	47.368	.887,	66.420	.000,
23	54	G	33.338	.005,	25.804	.206,	27.844	.074,	31.792	.010,	25.942	.192,	27.055	.110,	24.470	.401,	35.276	.002,
OK 24	62	A	18.603	.482,	25.583	.015,	29.357	.002,	23.663	.038,	29.984	.002,	20.509	.186,	19.775	.268,	27.364	.006,
25	14	G	51.702	.001,	40.835	.181,	46.029	.013,	54.763	.000,	40.048	.268,	42.750	.069,	38.929	.468,	57.867	.000,
26	46	G	37.814	.031,	33.118	.322,	44.109	.001,	37.705	.033,	49.943	.000,	37.580	.035,	31.952	.578,	46.870	.000,
OK 27	55	C	18.858	.160,	23.232	.018,	15.939	.687,	26.829	.003,	37.846	.000,	22.749	.023,	19.662	.107,	26.928	.003,
28	69	G	49.979	.002,	45.857	.015,	47.108	.008,	41.742	.116,	55.512	.000,	42.216	.091,	37.953	.768,	52.752	.000,
OK 29	13	B	12.858	.125,	10.007	.522,	16.788	.018,	13.170	.107,	20.618	.003,	14.782	.048,	14.181	.065,	13.275	.113,

GROUP H

CASE	Handwritten	Actual	A	p	B	p	C	p	D	p	E	p	F	p	G	p	H	p
OK 1	8	D	24.591	.211,	32.016	.005,	29.243	.021,	23.253	.412,	31.801	.006,	25.902	.110,	28.659	.028,	24.618	.208,
2	12	H	27.590	.005,	27.380	.005,	27.871	.004,	21.638	.090,	22.233	.067,	23.323	.039,	24.204	.025,	17.361	.765,
3	13	H	35.287	.011,	28.578	.302,	34.612	.015,	33.434	.027,	44.263	.000,	30.520	.114,	33.815	.022,	27.533	.509,
4	28	H	18.314	.038,	18.044	.043,	22.667	.004,	18.087	.042,	20.607	.012,	15.751	.136,	18.086	.042,	12.518	.683,
5	29	H	41.762	.063,	43.232	.030,	38.897	.264,	46.168	.007,	44.551	.016,	42.864	.036,	43.447	.027,	37.407	.556,
6	31	H	25.655	.008,	21.342	.068,	25.816	.007,	22.658	.035,	28.995	.001,	23.918	.019,	25.308	.009,	16.298	.851,
7	37	H	60.617	.000,	64.415	.000,	58.690	.001,	62.149	.000,	69.322	.000,	61.007	.000,	63.141	.000,	45.368	.997,
8	42	H	30.524	.045,	40.307	.000,	35.999	.002,	27.954	.127,	34.901	.004,	30.303	.039,	34.795	.004,	24.338	.777,
9	45	H	36.587	.004,	33.379	.021,	33.713	.018,	29.831	.123,	45.090	.000,	33.760	.017,	34.826	.010,	26.060	.808,
10	52	H	58.727	.001,	52.149	.014,	53.149	.009,	49.311	.058,	59.333	.000,	47.071	.178,	48.107	.106,	44.532	.634,
11	75	H	27.585	.021,	26.378	.039,	29.599	.008,	25.893	.050,	28.327	.015,	30.374	.005,	30.744	.004,	20.206	.857,

NUMBER OF CASES CLASSIFIED INTO GROUP -

GROUP	A	B	C	D	E	F	G	H
A	6	1	1	1	0	0	1	1
B	0	6	1	0	1	0	2	0
C	0	1	5	1	1	2	1	2

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APPENDIX D

Computer Printouts for the Rubin-Friedman Similarity Coefficient Method

R-TYPE FACTOR ANALYSIS OF 27 VARIABLES

ROTATED FACTOR MATRIX

VARIABLE	FACTOR 1 (affection)	2 (rational inhibited ego)	3	4 (intellectual regard)	5 (interpersonal)	6 (group ego)	
Tc 1	0.43527	-0.69623	~~0.07313~~	~~-0.05937~~	~~0.09157~~	~~-0.03717~~	time competence (present orientated)
I 2	0.96128	-0.13235	~~-0.04619~~	~~0.05616~~	~~0.09707~~	~~-0.01962~~	inner support
SAV 3	0.73233	~~-0.05926~~	0.28784	0.16579	~~0.07765~~	0.17605	self actualizing value
Ex 4	0.81077	-0.12528	0.12600	-0.17230	~~-0.00728~~	-0.28781	existentiality
Fr 5	0.82783	~~0.04851~~	-0.15731	~~0.07248~~	0.10586	~~0.04767~~	feeling reactivity
S 6	0.82605	~~-0.10387~~	~~0.10792~~	0.13396	0.13741	~~0.04236~~	spontaneity
Sr 7	0.61369	-0.15851	~~0.00971~~	0.12568	0.16962	0.37426	self regard
Sa 8	0.70473	-0.33032	~~-0.20029~~	-0.16957	~~0.07449~~	0.10330	self acceptance
Nc 9	0.41771	0.15022	~~-0.02274~~	-0.61995	-0.11695	-0.16710	nature of man
Sy 10	0.55521	~~0.08585~~	-0.60888	0.27155	~~0.05984~~	~~-0.00746~~	synergy
A 11	0.79741	~~0.01415~~	~~-0.00828~~	~~-0.01790~~	0.14526	~~0.11094~~	aggression
C 12	0.86006	~~-0.03131~~	~~-0.06581~~	~~-0.00864~~	~~0.02546~~	~~0.08724~~	intimacy
13	~~0.06297~~	-0.52019	0.19939	0.38899	~~-0.03385~~	0.47024	
14	~~0.00479~~	-0.46380	~~0.02119~~	0.17347	0.29482	0.53901	ego groups
15	0.20341	-0.74823	~~0.02759~~	~~0.01211~~	~~0.08435~~	0.29718	ego self
16	~~-0.03249~~	-0.76188	0.13016	0.17701	0.17656	0.19797	
17	0.24253	-0.30678	-0.15639	~~0.04187~~	0.36091	0.64684	
18	0.12075	-0.26318	0.17702	~~0.06812~~	~~-0.04439~~	0.78319	
19	~~0.02780~~	-0.78225	0.15113	0.28525	0.19337	0.32087	integrity
20	~~0.00616~~	-0.38394	~~0.00771~~	0.72338	0.25477	0.14495	autonomy
21	-0.13055	-0.19651	0.01563	0.72315	0.19528	0.23243	trust
22	0.23554	-0.44542	~~0.07477~~	0.14945	0.60848	~~-0.00816~~	self
23	0.18586	-0.22149	0.20815	0.17318	0.72114	0.16507	interpersonal rel.
24	0.29132	~~-0.00843~~	0.15421	~~0.07509~~	0.79533	0.12779	
25	~~-0.08083~~	-0.20769	0.75452	~~-0.04494~~	0.21687	0.14709	
26	-0.15019	-0.35582	0.54174	~~-0.06767~~	0.47302	-0.16844	
27	~~-0.07300~~	-0.47813	0.43217	~~-0.06499~~	0.37002	0.32748	job satisfaction

these are standard scores — sum should be 0 $\left(\sum_{i=1}^{N} x_{mi} = 0\right)$

FACTOR SCORES

CASE						
1	-1.45274	-1.22116	0.03281	-1.23809	-0.59224	1.40776
2	-1.38040	2.73627	-1.19285	-1.36388	-0.61407	1.14493
3	-0.59849	0.86041	1.15724	0.35886	-2.29023	0.01606
4	-1.39137	-0.16449	0.30141	-1.54004	-0.41184	0.44571
5	-1.05000	-0.19761	0.33465	0.33174	-0.96818	0.58881
6	-0.20217	-1.10546	1.14272	0.30595	-0.05551	0.01941
7	1.17484	-0.63743	1.16794	0.83225	0.48029	1.02801
8	0.63329	-0.24486	0.29979	0.05205	0.38536	0.19861
9	0.41142	0.39203	0.82537	-1.05978	0.44074	-0.31371
10	-0.19146	-0.47639	0.53487	1.87803	-0.49294	-0.22589
11	1.07613	0.47959	0.21505	-0.67090	-0.73095	-0.46486
12	1.35290	-1.02272	0.31163	-0.77956	0.79867	0.14746
13	0.46392	0.05610	0.74792	1.67647	-0.53098	-0.26579
14	-0.97268	2.14129	-0.32292	-0.60281	-1.76605	-1.34834
15	-0.69731	-1.53406	-2.01923	-1.55884	1.10553	0.39918
16	0.38621	-1.45355	0.53045	-0.77005	-1.50455	-2.07886
17	-0.43339	0.31525	-1.58728	-0.06427	1.23007	0.07067
18	-1.95189	0.54253	-0.08647	1.19095	0.90818	0.79408
19	-0.82332	0.83257	1.94981	-0.39124	0.60112	-0.35732
20	0.17324	0.42604	-0.53197	0.22660	-1.15906	0.43303
21	-1.43852	2.25432	-0.75431	-0.25847	0.30403	0.15796
22	-0.42804	0.74265	1.40942	0.69906	-0.22293	0.65163
23	-2.07240	-1.29191	-0.52359	-2.20500	0.27746	1.43609
24	-0.51062	0.37722	1.41654	-1.73930	1.08540	-2.18348
25	1.33186	-0.28284	1.18370	-0.05372	-1.92337	-1.46592
26	0.09645	-0.65909	0.55465	0.21289	-0.03707	0.81202
27	-0.95254	0.07145	-1.43319	2.99748	-0.37419	-0.37817
28	0.56180	-0.80907	-0.61136	0.80831	-0.29326	0.37595
29	0.84735	-0.78060	-0.67955	1.13587	-0.20342	-1.63826
30	0.54678	1.11383	-0.95618	0.93221	1.15988	-0.30613
31	0.07304	-0.61030	-0.12072	0.26380	1.09226	0.41751
32	0.78016	-0.56403	-0.79435	1.67218	1.37724	-0.32790
33	-0.00922	3.30897	0.22659	0.66230	1.10599	0.38981
34	-1.53807	-0.25198	1.06995	1.38216	1.10914	-0.19826
35	0.94246	-0.35088	0.60608	-0.77479	0.34128	0.94415
36	-0.12616	-0.88864	0.31309	-0.07169	-1.20024	1.28370
37	1.58994	-0.27911	-3.01675	1.47235	0.64870	-0.89611
38	1.00824	0.91890	-1.44074	-0.39663	-0.55590	-0.95662
39	-1.45786	-0.15004	0.57575	0.63479	-0.69445	-0.39762
40	-0.14523	-0.26145	-1.19268	-0.96439	0.00446	-0.42709
41	0.09942	-0.28879	1.58060	-0.23652	-0.62802	1.96164
42	-0.80601	-1.50430	0.97095	2.07157	1.06426	-1.01298
43	1.64476	-0.70657	-1.10390	0.56803	-0.68129	0.83519

44	0.90474	-0.20500	0.13543	-0.47915	0.03670	1.28103
45	1.45094	-0.20753	0.59600	0.20466	0.42590	1.03071
46	-0.07479	1.35829	0.28817	-1.61475	0.23552	-0.73429
47	0.90501	0.23103	1.17789	-0.11986	0.31814	-0.34980
48	-0.93101	-1.24427	-1.73108	-1.68876	-3.12990	-1.09809
49	-0.79551	-0.52161	-1.01864	-0.42815	-1.50406	1.54617
50	-1.61746	-1.45870	-0.93845	0.55456	-1.57958	1.03089
51	0.00864	-0.48758	0.07089	-0.15759	1.18754	0.26953
52	0.80802	0.35744	-1.36512	-0.27636	0.52265	1.46009
53	0.62105	-0.36663	0.80958	1.09260	-0.80757	-0.16285
54	-1.20886	1.95243	-0.38181	-0.23697	0.64808	0.86374
55	0.10620	-0.05260	-0.98772	0.89377	-0.14428	0.42754
56	0.29701	-1.02482	-0.31621	-0.49502	0.18985	0.25505
57	1.14475	0.09672	1.15338	-0.48194	0.92298	-0.45300
58	0.09275	-0.61013	0.17307	0.08384	-0.87187	0.32573
59	0.54740	0.00870	1.97861	-0.30612	-1.43579	0.00255
60	-0.07577	0.43365	-0.66830	0.87246	-2.61538	0.69176
61	0.28168	0.70700	-0.08317	0.91188	0.05778	-0.26650
62	1.00838	-0.37989	0.17315	-0.78804	-1.15798	-1.67154
63	0.69158	2.01311	-0.26269	-0.23197	-0.54249	0.59054
64	0.76004	-0.40855	0.29111	0.23248	-0.21012	0.56513
65	-0.96849	-1.78212	-0.16857	0.52414	0.38439	-0.49702
66	-1.98132	0.88817	-1.50920	-0.44672	0.25454	-1.58275
67	-0.39249	0.74715	-0.67018	1.18651	0.02989	0.51177
68	0.49647	-0.03149	-0.68301	-0.43894	-0.43767	0.32375
69	-1.81119	-0.81484	-0.55106	-1.07897	1.18386	0.67905
70	1.84253	-0.23934	-0.22591	-0.36025	1.50514	-0.45383
71	-1.30220	-0.28498	1.40260	0.35504	0.43533	-0.76839
72	0.36506	-0.79373	-0.12125	0.89184	0.99458	-0.31545
73	0.54098	0.60448	-1.05732	-0.81389	0.10207	-0.61107
74	-1.71865	1.09598	0.18515	1.12223	-0.41562	-3.09750
75	-0.97668	1.43164	1.09857	-0.27214	-0.00082	2.31529
76	-0.39985	-0.70363	-0.63550	-0.76006	0.85369	0.08995
77	0.11518	0.76608	1.60808	-0.81149	0.99429	-0.76251
78	0.05494	-0.11392	1.59184	0.14602	-0.57119	0.91733
79	1.83620	0.26760	-0.62526	-0.08832	1.75784	-0.81509
80	-0.72940	-1.06424	0.18014	-2.32385	1.23042	-2.25627

Rubin - Friedman - Similarity

AVERAGE SIMILARITY OF EACH OBJECT TO EACH GROUP

AVERAGE SIMIL. FROM OBJECT	IN SET		TO SETS 1	2	3	4	5	
1	2	2	0.266	0.495	0.266	0.197	0.337	8 cases - some similarity structure.
2 U*	2	4	0.183	0.178	0.127	0.151	0.171	
3	4	1	0.269	0.125	0.123	0.366	0.283	
1 4	1	1	0.497	0.242	0.243	0.294	0.187	
5 U*	1	2	0.388	0.440	0.257	0.199	0.458	
6 U	1	1	0.426	0.210	0.215	0.368	0.317	
7	1	1	0.358	0.327	0.280	0.298	0.162	
8	1	1	0.544	0.285	0.310	0.405	0.112	
9	4	4	0.348	0.208	0.269	0.510	0.175	
10	1	3	0.426	0.133	0.299	0.300	0.196	
11	4	1	0.332	0.223	0.289	0.429	0.100	
12 U	1	1	0.361	0.352	0.336	0.306	0.325	
13 U	1	1	0.396	0.121	0.299	0.391	0.125	
14 U*	3	4	0.185	0.283	0.279	0.190	0.254	
15	5	5	0.198	0.304	0.160	0.175	0.536	
16 U*	3	5	0.288	0.200	0.263	0.198	0.225	
17 U	4	2	0.360	0.192	0.208	0.405	0.400	
18	2	2	0.295	0.410	0.185	0.293	0.225	
19	4	4	0.229	0.229	0.234	0.483	0.313	
20	1	1	0.457	0.290	0.204	0.349	0.104	
21	2	2	0.313	0.347	0.313	0.318	0.083	
22	4	1	0.331	0.240	0.111	0.396	0.271	
23	2	2	0.197	0.428	0.199	0.150	0.254	
24	5	5	0.175	0.144	0.160	0.301	0.469	
25 U*	1	3	0.374	0.079	0.352	0.270	0.137	
26	1	1	0.557	0.279	0.243	0.294	0.104	
27	4	5	0.244	0.194	0.264	0.365	0.246	
28	1	3	0.478	0.335	0.329	0.286	0.137	
29	3	3	0.333	0.260	0.370	0.251	0.158	
30	4	4	0.279	0.210	0.275	0.404	0.162	
31	1	1	0.552	0.323	0.264	0.256	0.250	
32	3	3	0.320	0.177	0.341	0.310	0.229	
33 U	1	4	0.303	0.194	0.190	0.207	0.258	
34 U	3	2	0.302	0.267	0.260	0.313	0.258	
35 U	1	1	0.439	0.310	0.368	0.342	0.067	
36	1	1	0.443	0.292	0.289	0.198	0.162	
37 U*	3	3	0.238	0.185	0.242	0.276	0.175	
38	4	3	0.240	0.140	0.301	0.399	0.125	

39	1	2	Ø.384	Ø.285	Ø.266	Ø.33Ø	Ø.Ø96
4Ø U	4	3	Ø.379	Ø.213	Ø.324	Ø.443	Ø.154
41	1	1	Ø.412	Ø.1Ø4	Ø.271	Ø.285	Ø.Ø75
42	5	3	Ø.143	Ø.2Ø2	Ø.266	Ø.221	Ø.49Ø
43	1	1	Ø.387	Ø.292	Ø.243	Ø.2ØØ	Ø.Ø87
44	1	1	Ø.449	Ø.331	Ø.37Ø	Ø.348	Ø.Ø54
45	1	1	Ø.44Ø	Ø.331	Ø.25Ø	Ø.299	Ø.Ø92
46	4	4	Ø.268	Ø.223	Ø.167	Ø.348	Ø.254
47	4	1	Ø.387	Ø.2Ø4	Ø.278	Ø.515	Ø.121
48	5	5	Ø.Ø85	Ø.194	Ø.22Ø	Ø.168	Ø.464
49	3	2	Ø.296	Ø.248	Ø.352	Ø.234	Ø.2Ø4
5Ø	2	2	Ø.2Ø8	Ø.387	Ø.241	Ø.137	Ø.142
51	1	1	Ø.549	Ø.262	Ø.313	Ø.292	Ø.258
52	4	1	Ø.3ØØ	Ø.269	Ø.278	Ø.427	Ø.121
53 U	4	1	Ø.375	Ø.15Ø	Ø.257	Ø.419	Ø.Ø96
54	2	2	Ø.324	Ø.461	Ø.269	Ø.25Ø	Ø.292
55 U x	1	4	Ø.461	Ø.258	Ø.31Ø	Ø.393	Ø.Ø87
56	1	1	Ø.495	Ø.35Ø	Ø.356	Ø.357	Ø.175
57	4	1	Ø.34Ø	Ø.198	Ø.345	Ø.458	Ø.271
58	1	1	Ø.571	Ø.256	Ø.271	Ø.263	Ø.112
59 U	1	1	Ø.4Ø4	Ø.1Ø8	Ø.315	Ø.371	Ø.Ø79
6Ø	1	3	Ø.347	Ø.287	Ø.146	Ø.31Ø	Ø.125
61 U	4	4	Ø.389	Ø.298	Ø.225	Ø.473	Ø.Ø83
62 U	3	3	Ø.355	Ø.2Ø6	Ø.378	Ø.215	Ø.125
63	1	4	Ø.433	Ø.3Ø4	Ø.25Ø	Ø.253	Ø.Ø67
64	1		Ø.555	Ø.296	Ø.285	Ø.3ØØ	Ø.Ø79
65 U	2	5	Ø.276	Ø.359	Ø.257	Ø.342	Ø.342
66	4	2	Ø.169	Ø.269	Ø.264	Ø.347	Ø.121
67	4	4	Ø.319	Ø.323	Ø.238	Ø.355	Ø.246
68	1	1	Ø.5Ø9	Ø.265	Ø.352	Ø.396	Ø.Ø88
69 U	2	2	Ø.362	Ø.396	Ø.275	Ø.212	Ø.267
7Ø U	1	1	Ø.362	Ø.24Ø	Ø.338	Ø.318	Ø.212
71	4	4	Ø.325	Ø.287	Ø.292	Ø.35Ø	Ø.242
72	1	3	Ø.43Ø	Ø.337	Ø.347	Ø.337	Ø.267
73	4	4	Ø.295	Ø.217	Ø.326	Ø.549	Ø.Ø96
74 U	2	5	Ø.26Ø	Ø.3Ø3	Ø.243	Ø.129	Ø.154
75 U x	3	2	Ø.232	Ø.31Ø	Ø.24Ø	Ø.279	Ø.3Ø4
76 U	1	2	Ø.4Ø4	Ø.352	Ø.373	Ø.349	Ø.379
77	4	4	Ø.255	Ø.167	Ø.22Ø	Ø.455	Ø.283
78	1	1	Ø.483	Ø.217	Ø.185	Ø.3Ø6	Ø.1Ø8
79	1	1	Ø.33Ø	Ø.3Ø4	Ø.192	Ø.255	Ø.121
8Ø	5	5	Ø.2Ø9	Ø.29Ø	Ø.269	Ø.127	Ø.5ØØ

DESCRIPTIONS OF STABLE AND UNSTABLE ELEMENTS
OBJECT STABILITY IS DEFINED AS (AVER. INSIDE SIMILARITY-SSTAR)/(1-SSTAR)-(MAX. AVER. OUTSIDE SIMILAR
WHERE SSTAR = BREAKING COEFF.
OR, IF NORMALIZATION WAS SUPPRESSED, AS AVER. INSIDE SIMIL.-MAX. AVER. OUTSIDE SIMIL.
AN OBJECT IS WEAKLY STABLE IF MAX AVER. OUTSIDE SIM. IS GREATER THAN SSTAR, UNSTABLE IF OBJECT STABIL

SET 1

OBJECT	TYPE	AVERAGE INSIDE SIMILARITY	MAX. AVERAGE OUTSIDE SIMILARITY	FROM SET	OBJECT STABILITY
4	STABLE	0.49694	0.30910	0	0.27188
5	UNSTABLE	0.38787	0.45833	5	-0.36879
6	UNSTABLE	0.42586	0.36806	4	-0.02175
7	STABLE	0.35846	0.32708	2	0.01326
8	STABLE	0.54351	0.40476	4	0.02978
10	STABLE	0.42586	0.30910	0	0.16900
12	UNSTABLE	0.36091	0.35208	2	-0.06408
13	UNSTABLE	0.39583	0.39087	4	-0.13902
20	STABLE	0.45711	0.34921	4	0.08447
25	UNSTABLE	0.37439	0.35185	3	-0.04383
26	STABLE	0.55698	0.30910	0	0.35879
28	STABLE	0.47794	0.33542	2	0.15924
31	STABLE	0.55208	0.32292	2	0.30699
33	UNSTABLE	0.30331	0.30910	0	-0.00838
35	UNSTABLE	0.43872	0.36805	3	-0.00312
36	STABLE	0.44301	0.30910	0	0.19383
39	STABLE	0.38419	0.33036	4	0.03991
41	STABLE	0.41176	0.30910	0	0.14860
43	STABLE	0.38725	0.30910	0	0.11312
44	STABLE	0.44914	0.37037	3	0.00446
45	STABLE	0.43995	0.33125	2	0.11773
51	STABLE	0.54902	0.31250	3	0.33625
55	UNSTABLE	0.46078	0.39285	4	-0.05142
56	STABLE	0.49510	0.35714	4	0.11378
58	STABLE	0.57108	0.30910	0	0.37918
59	UNSTABLE	0.40380	0.37103	4	-0.06331
60	STABLE	0.34681	0.30953	4	0.05321
63	STABLE	0.43260	0.30910	0	0.17875
64	STABLE	0.55515	0.30910	0	0.35613
68	STABLE	0.50919	0.39583	4	0.00900
70	UNSTABLE	0.36213	0.33797	3	-0.01663
72	STABLE	0.42953	0.34722	3	0.05098
76	UNSTABLE	0.40380	0.37917	5	-0.08962
78	STABLE	0.48345	0.30910	0	0.25236
79	STABLE	0.32966	0.30910	0	0.02976

AVERAGE STABILITY OF THIS GROUP = Ø.Ø8287

SET 2

OBJECT	TYPE	AVERAGE INSIDE SIMILARITY	MAX. AVERAGE OUTSIDE SIMILARITY	FROM SET	OBJECT STABILITY
1	STABLE	Ø.49537	Ø.3375Ø	5	Ø.17772
2	UNSTABLE ax4	Ø.17824	Ø.3Ø91Ø	Ø	-Ø.1894Ø
18	STABLE	Ø.4Ø972	Ø.3Ø91Ø	Ø	Ø.14564
21	STABLE	Ø.34722	Ø.31845	4	Ø.Ø2492
23	STABLE	Ø.42824	Ø.3Ø91Ø	Ø	Ø.17245
5Ø	STABLE	Ø.38657	Ø.3Ø91Ø	Ø	Ø.11214
54	STABLE	Ø.46Ø65	Ø.32381	1	Ø.17176
65	UNSTABLE ax5	Ø.3588Ø	Ø.34226	4	-Ø.Ø3535
69	UNSTABLE	Ø.39583	Ø.36191	1	-Ø.Ø453Ø
74	UNSTABLE ax5	Ø.3Ø324	Ø.3Ø91Ø	Ø	-Ø.ØØ848
				17	

AVERAGE STABILITY OF THIS GROUP = Ø.Ø5261

SET 3

OBJECT	TYPE	AVERAGE INSIDE SIMILARITY	MAX. AVERAGE OUTSIDE SIMILARITY	FROM SET	OBJECT STABILITY
14	UNSTABLE ax4	Ø.27864	Ø.3Ø91Ø	Ø	-Ø.Ø44Ø8
16	UNSTABLE ax5	Ø.263Ø2	Ø.3Ø91Ø	Ø	-Ø.Ø667Ø
29	STABLE	Ø.36979	Ø.33334	1	Ø.ØØ943
32	STABLE	Ø.34115	Ø.32Ø24	1	Ø.Ø1Ø35
34	UNSTABLE ax2	Ø.26Ø42	Ø.3125Ø	4	-Ø.Ø8146
37	UNSTABLE	Ø.24219	Ø.3Ø91Ø	Ø	-Ø.Ø9685
49	STABLE ax2	Ø.35156	Ø.3Ø91Ø	Ø	Ø.Ø6146
62	UNSTABLE	Ø.3776Ø	Ø.35476	1	-Ø.Ø4858
75	UNSTABLE ax2	Ø.23958	Ø.31Ø41	2	-Ø.1Ø487

AVERAGE STABILITY OF THIS GROUP = -Ø.Ø4Ø14

SET 4

OBJECT	TYPE	AVERAGE INSIDE SIMILARITY	MAX. AVERAGE OUTSIDE SIMILARITY	FROM SET	OBJECT STABILITY
3	STABLE ax1	Ø.36563	Ø.3Ø91Ø	Ø	Ø.Ø8182
9	STABLE	Ø.51Ø42	Ø.34822	1	Ø.16483
11	STABLE ax1	Ø.42917	Ø.33214	1	Ø.Ø9923
17	UNSTABLE ax2	Ø.4Ø521	Ø.4ØØØØ	5	-Ø.15498
19	STABLE	Ø.48333	Ø.3125Ø	5	Ø.24118

143

22

22	STABLE ax1	0.39583	0.33095	1	0.05484
27	STABLE ax5	0.36458	0.30910	0	0.08030
30	STABLE	0.40417	0.30910	0	0.13760
38	STABLE ax3	0.39896	0.30910	0	0.13006
40	UNSTABLE ax3	0.44271	0.37917	1	-0.03330
46	STABLE	0.34792	0.30910	0	0.05618
47	STABLE ax1	0.51458	0.38691	1	0.04569
52	STABLE ax1	0.42708	0.30910	0	0.17077
53	UNSTABLE ax1	0.41875	0.37500	1	-0.05450
57	STABLE ax1	0.45834	0.34491	3	0.10015
61	UNSTABLE	0.47292	0.38869	1	-0.02039
66	STABLE ax2	0.34687	0.30910	0	0.05468
67	STABLE	0.35521	0.32292	2	0.02203
71	STABLE	0.35000	0.32500	1	0.00776
73	STABLE	0.54896	0.32639	3	0.29124
77	STABLE	0.45521	0.30910	0	0.21148

AVERAGE STABILITY OF THIS GROUP = 0.08032

SET 5

OBJECT	TYPE	AVERAGE INSIDE SIMILARITY	MAX. AVERAGE OUTSIDE SIMILARITY	FROM SET	OBJECT STABILITY
15	STABLE	0.53646	0.30910	0	0.32908
24	STABLE	0.46875	0.30910	0	0.23108
42	STABLE ax3	0.48959	0.30910	0	0.26124
48	STABLE	0.46354	0.30910	0	0.22354
80	STABLE	0.50000	0.30910	0	0.27631

AVERAGE STABILITY OF THIS GROUP = 0.26425

APPENDIX E

Computer Printouts for the Rubin-Friedman Distance Coefficient Method

23 ROBIN - FRIEDMAN - DISTANCE

FINAL SET MEMBERSHIPS FOR BEST PARTITION - FINAL VALUE= 0.45283E 02

MEMBERS OF GROUP 1

1	9	11	15	16	23	36	41	45	49	52	55
56	59	62	64	68	70	75	79				

MEMBERS OF GROUP 2

3	5	17	24	29	31	37	53	65	69	72	77

MEMBERS OF GROUP 3

18	33	34	42	66	74

MEMBERS OF GROUP 4

6	7	8	20	25	26	28	38	40	46	47	50
51	54	57	58	60	63	73	76	78	80		

MEMBERS OF GROUP 5

10	13	14	19	21	22	30	32	39	61	67	71

MEMBERS OF GROUP 6

2	4	12	27	35	43	44	48

POOLED SCATTER MATRIX

		VARIABLE 1	2	3	4	5	6
VARIABLE	1	0.7668	0.2688	0.0716	0.3595	0.1577	-0.1517
VARIABLE	2	0.2688	0.8775	-0.0572	-0.1937	-0.0508	-0.0131
VARIABLE	3	0.0716	-0.0572	0.9539	0.0397	-0.0413	-0.0336
VARIABLE	4	0.3595	-0.1937	0.0397	0.6175	-0.1282	0.2494
VARIABLE	5	0.1577	-0.0508	-0.0413	-0.1282	0.8991	0.1220
VARIABLE	6	-0.1517	-0.0131	-0.0336	0.2494	0.1220	0.8007

LOG RATIO OF DETERM T TO DETERM W = 4.00688

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WEIGHTED DIST. BETWEEN EACH OBJECT AND EACH GROUP

OBJECT	IN GP	GROUP 1	2	3	4	5	6
1	(1)	0.0261	0.1113	0.3483	0.0407	0.2698	0.0459
2	(6)	0.0898	0.3333	0.5805	0.2517	0.5706	0.0142
3	(2)	0.2525	0.0225	0.1543	0.0964	0.0589	0.1936
4	(6)	0.0599	0.3341	0.5945	0.2362	0.5898	0.0019
5	(2)	0.3053	0.0068	0.1194	0.1282	0.0347	0.2307
6	(4)	0.1182	0.0218	0.2110	0.0209	0.1103	0.1208
7	(4)	0.0338	0.0893	0.3235	0.0237	0.2332	0.0562
8	(4)	0.0570	0.0451	0.2629	0.0026	0.1622	0.0786
9	(1)	0.0154	0.1121	0.3561	0.0299	0.2735	0.0362
10	(5)	0.6465	0.0584	0.0451	0.3742	0.0070	0.4064
11	(1)	0.0107	0.1791	0.4359	0.0785	0.3730	0.0139
12	(6)	0.0738	0.3472	0.6082	0.2587	0.6131	0.0071
13	(5)	0.5103	0.0317	0.0681	0.2676	0.0057	0.3365
14	(5)	0.5067	0.0443	0.0797	0.2717	0.0193	0.3259
15	(1)	0.0300	0.2087	0.4633	0.1249	0.4225	0.0182
16	(1)	0.0347	0.1722	0.4200	0.0879	0.3642	0.0293
17	(2)	0.3075	0.0075	0.1204	0.1304	0.0351	0.2272
18	(3)	1.3516	0.2664	0.0045	0.9804	0.1068	0.7470
19	(5)	0.4782	0.0306	0.0770	0.2485	0.0129	0.3196
20	(4)	0.0589	0.0543	0.2704	0.0076	0.1692	0.0753
21	(5)	0.8106	0.1066	0.0319	0.5151	0.0236	0.4822
22	(5)	0.4619	0.0265	0.0785	0.2346	0.0083	0.3124
23	(1)	0.0350	0.2205	0.4700	0.1347	0.4301	0.0207
24	(2)	0.2892	0.0192	0.1414	0.1249	0.0611	0.2139
25	(4)	0.0852	0.0566	0.2640	0.0226	0.1690	0.0893
26	(4)	0.0395	0.0624	0.2883	0.0051	0.1907	0.0655
27	(6)	0.0608	0.2986	0.5518	0.2100	0.5395	0.0087
28	(4)	0.0563	0.0524	0.2720	0.0079	0.1737	0.0759
29	(2)	0.3349	0.0119	0.1180	0.1465	0.0377	0.2407
30	(5)	0.5965	0.0474	0.0536	0.3381	0.0074	0.3783
31	(2)	0.1524	0.0106	0.1857	0.0365	0.0856	0.1422
32	(5)	0.5070	0.0319	0.0734	0.2728	0.0169	0.3340
33	(3)	1.6531	0.3747	0.0134	1.2486	0.1786	0.8812
34	(3)	1.3614	0.2660	0.0023	0.9858	0.1082	0.7536
35	(6)	0.0399	0.2926	0.5554	0.1917	0.5345	0.0034
36	(1)	0.0091	0.1779	0.4324	0.0778	0.3683	0.0173
37	(2)	0.3027	0.0282	0.1513	0.1433	0.0732	0.2162
38	(4)	0.0581	0.0674	0.2888	0.0188	0.1948	0.0680
39	(5)	0.6579	0.0611	0.0411	0.3833	0.0062	0.4116

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40	(4)	0.0240	0.0874	0.3245	0.0174	0.2374	0.0459
41	(1)	0.0251	0.2161	0.4692	0.1181	0.4169	0.0181
42	(3)	1.3039	0.2466	0.0058	0.9357	0.1030	0.7265
43	(6)	0.0367	0.2621	0.5232	0.1642	0.4908	0.0077
44	(6)	0.0356	0.2846	0.5473	0.1822	0.5218	0.0028
45	(1)	0.0117	0.1890	0.4476	0.0903	0.3878	0.0155
46	(4)	0.0970	0.0416	0.2408	0.0226	0.1423	0.0990
47	(4)	0.0659	0.0476	0.2623	0.0083	0.1624	0.0827
48	(6)	0.1068	0.3578	0.6024	0.2811	0.6135	0.0176
49	(1)	0.0167	0.1729	0.4223	0.0792	0.3576	0.0213
50	(4)	0.1009	0.0555	0.2532	0.0368	0.1600	0.1014
51	(4)	0.1068	0.0226	0.2173	0.0180	0.1169	0.1132
52	(1)	0.0133	0.1767	0.4316	0.0835	0.3680	0.0176
53	(2)	0.2661	0.0078	0.1362	0.0968	0.0401	0.2053
54	(4)	0.0801	0.0460	0.2538	0.0222	0.1615	0.0935
55	(1)	0.0032	0.1504	0.4048	0.0550	0.3344	0.0183
56	(1)	0.0022	0.1445	0.3998	0.0505	0.3295	0.0209
57	(4)	0.0418	0.0749	0.3044	0.0169	0.2130	0.0618
58	(4)	0.0245	0.0811	0.3158	0.0094	0.2228	0.0506
59	(1)	0.0230	0.1410	0.3846	0.0527	0.3081	0.0342
60	(4)	0.0886	0.0656	0.2703	0.0317	0.1724	0.0889
61	(5)	0.4337	0.0167	0.0809	0.2101	0.0067	0.2961
62	(1)	0.0249	0.1937	0.4488	0.0989	0.3964	0.0172
63	(4)	0.0927	0.0489	0.2502	0.0235	0.1472	0.0949
64	(1)	0.0066	0.1223	0.3715	0.0327	0.2897	0.0300
65	(2)	0.3421	0.0088	0.1088	0.1519	0.0312	0.2491
66	(3)	1.1160	0.1889	0.0094	0.7719	0.0670	0.6298
67	(5)	0.6231	0.0539	0.0475	0.3577	0.0039	0.3931
68	(1)	0.0045	0.1287	0.3795	0.0368	0.3005	0.0249
69	(2)	0.2413	0.0129	0.1498	0.0945	0.0606	0.1912
70	(1)	0.0210	0.1387	0.3890	0.0585	0.3189	0.0317
71	(5)	0.7774	0.0887	0.0273	0.4810	0.0159	0.4722
72	(2)	0.2872	0.0031	0.1253	0.1130	0.0371	0.2192
73	(4)	0.0457	0.0641	0.2893	0.0107	0.1946	0.0634
74	(3)	1.5516	0.3347	0.0091	1.1554	0.1624	0.8370
75	(1)	0.0199	0.1747	0.4243	0.0878	0.3639	0.0252
76	(4)	0.0475	0.0554	0.2783	0.0083	0.1843	0.0700
77	(2)	0.2354	0.0121	0.1534	0.0848	0.0601	0.1871
78	(4)	0.0448	0.0738	0.2978	0.0148	0.2015	0.0660
79	(1)	0.0221	0.1468	0.3966	0.0665	0.3263	0.0311
80	(4)	0.0898	0.0733	0.2844	0.0496	0.2078	0.0865

PLOT OF OBJECTS IN SPACE OF EIGENVECTORS 1 AND 2
AN A INDICATES 1 OR MORE OBJECTS IN GROUP 1, B IN GROUP 2, ETC., Z INDICATES OVERLAP BETWEEN TWO GR

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   1.137*
        *
        *
        *
        *
        *
        *
        *
        *
   0.629*
        *
        *
        *
        *
        *
        *                                                                   D
        *                                                                                    A
        *  C      C                                  B                   D
   0.120*                                    E        BBBBB          D      D      A   AAA   A
        *      C       C          E                    B   B    B   D         D D      A    A        F
        *                                E                  B             DD D  D   A    AA          F
        *       C                    EE       EE                        D D  D  D    AA    AA     F  F
        *                               E   E E          B                   D            AA
        *C                        E                                         D          A      A
        *                                     E                         D
        *                                                  B              D                           F
        *
  -0.388*
        *
        *
        *
        *
        *
        *
        *
        *
        *
  -1.912*
        ************************************************************************************************
        *               *               *               *               *               *
         -1.912          -1.404          -0.896          -0.388           0.120           0.629
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APPROVAL SHEET

This dissertation submitted by James W. Graham has been read and approved by members of the School of Education and the Department of Psychology.

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated, and that the dissertation is now given final approval with reference to content, form and mechanical accuracy.

The dissertation is therefore accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

January 13, 1972
Date

Samuel T. Mayo
Signature of Advisor